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Publishers Letter

Dear Reader,

MY first two months as a publisher has produced a strange mixture of experiences. Help and support has come from the most unexpected of sources, for which I am extremely grateful, yet some people and organisations who are benefitted by the magazine have shown a strange apathy.

United Kingdom distribution is being handled by Computer Bookshop of 43-45 Temple Street, Birmingham, to whom all enquiries for bulk purchase should be directed. Through their efforts Liverpool Software Gazette should be available at every computer store in this country.

United States distribution is being handled by Bits Inc. of Peterborough, New Hampshire, and I am currently in the processs of arranging European distribution.

This issue of the magazine has more pages than the first and more careful proof reading plus less undue haste should have resulted in less errors. For this improvement to continue we need more advertising as this is the lifeblood of any magazine, anyone interested should look at the advertising details elsewhere within these covers.

To finish may I once again exhort you to communicate with us your likes, dislikes, grievances, contributions etc., as these too will improve the magazine.

B. Everiss

BRUCE EVERISS

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LIVERPOOL SOFTWARE GAZETTE

EDITORIAL

PUBLICATION of the first edition of Liverpool Software Gazette produced as wide a range of comments, suggestions, criticisms and appreciation as we had feared! As a result there are a number of changes in the presentation and format of this issue. As far as possible all listings, however small, are reproduced directly from the respective machines listing—based on the well known premise that is the machine typed it, it must have accepted it in the first place!

Additionally, many people wanted to adapt a particular program to run on their machine—in future we will try and publish conversion hints along with the article. I believe this months edition shows many improvements over its predecessor. Contributions, letters, comments are always welcome.

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Publisher: Bruce Everiss.
Editor: Carl Phillips.
Editorial Assistant: Marie Beard.
Contributing Editors: John Stout, Dr. Martin Beer, Dave Straker.
Advertising: Nikki Devereux.
Subscriptions: Christine Crofton.
Artwork: Peter Croft.

THE LIVERPOOL SOFTWARE GAZETTE is published bi-monthly by Microdigital, 14 Castle Street, Liverpool, L2 0TA.

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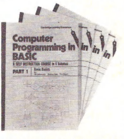

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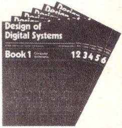

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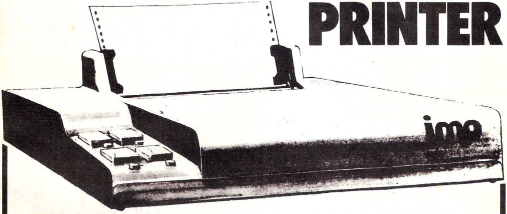

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Dungeons & Dragons Revisited

by D. Straker

IN the beginning was man, and man made war. Soon man found that war was expensive both in money and men, so in between wars, whilst saving up for the next one, he invented the wargame, in order to satisfy his lust for conflict.

As man evolved, so did his games. Some became fixed with simplified rules and playing area, such that the notion of human conflict became an abstract conflict, such as chess or draughts. Others, ever trying to simulate the real thing, became large and complex, with dimly defined borders, such as the modern wargame.

The modern trend towards pacifism, coupled with the enormously popular novels (?) of J.R.R. Tolkein (notably The Lord of the Rings) spawned the current drift away from warring and towards more fantastic forms of gaming. The forerunnner of most of these is a game called Dungeons and Dragons (D & D to initiates) which emerged in 1973 from Gary Gygax and Dave Arneson in America.

The players now, instead of taking the parts of soldiers, play as hobbits, magicians, etc. exploring unknown caverns in search of treasure and adventure.

Conflict still arises, such as when you meet a hostile Troll, but it is less significant, and relates less to human activities. These games require one experienced player to take the part of referee and games-master. He plans the caves and decides upon the action, often depending upon the roll of a die.

Inevitably, perhaps the role of games-master was taken over by the computer. The first of these was Wil Crowther's 'Adventure', which now occupies many hours of processor time on PDP 11's across the globe. A successor is Zork, written in 1977 at MIT, which can completely fill a DEC 10 (much larger than PDP 11). These games are all based upon the question and answer, e.g.

Program: Suddenly a big goblin jumps out of the door on the left. He has a big sword and a mean look.
Player: Hit goblin.
Program: With what?
Player: My fist.
Program: The goblin jumps aside, and takes a swipe at you. His sword narrowly misses, and rings off the stone to your right.
Player: Light flare.
Program: The goblin is dazzled, he flees leaving behind a small brown package.
Player: Open package.
Program: Inside is a silver snuff box with a curious inscription on the top.
Player: Read inscription.
Program: SHALACZ MARAB!! You are transported to a massive room.
Etc.

The complexity of such games depends upon the ingenuity of the programmer and the amount of recallable space in the computer. Much information is held in tables. These tables may be held in memory, but if a disk system is available files of this information may be used to expand the game almost infinitely.

This article is not written to completely describe a program, but as a stimulus, a provider of basic ideas and a simple systems analysis of the problem.

The program(s?) must describe the player, the other creatures and monsters, the environment and cater for as many interactions between them as possible.

A goal to aim at is essential, whether it be to find the lost crown of Albaroc, rescue Alesia the Beautiful from the goblin hordes, or simply to acquire as much experience and treasure as possible.

Chronology Log

If possible a log should be kept of all activities, so that past experiences can be referenced. The following other tables may be needed:—

Player Table

1. Basic Characteristics—a fixed number of levels for each, e.g. 16 (4 bits?). Set at initialisation, either randomly or by player. They may be affected by play, e.g. strength is decreased by a wound, and charisma is increased by charming monsters, e.g.

strength — physical strength
wisdom — ability to understand creatures
dexterity — physical co-ordination
intelligence — ability to understand problems
charisma — personality appeal
constitution — health and physical stamina

2. Possessions—

Limits that player may carry, e.g. 100 kg (may depend upon strength) plus all items carried, including weapons, armour, heavy treasure, magic items, food, etc., taken from the carried items tables.

3. Others—

including name, race and any other special attributes a player may have, such as mobility, spell-maker, etc.

Creature and Monster Table

Each creature or monster has an entry, describing: species, strength range, friendliness, special weaknesses (e.g. fire), value if defeated (e.g. strength + 1, wisdom + 1), etc.

Carried Items Tables

These may be divided into:

1. **Armoury Items**

Weapons for physical attack and defence, such as swords, shields etc. Each has attack and defence value, cost etc.

2. **Survival Items**

Such as lights, rations etc., each having a cost and duration of use.

3. **Magical Items**

Each with name, requirement for use, (e.g. wisdom of 10) value, and special attributes (e.g. wards off spectres) etc.

4. **Treasure Items**

Such as gold and jewels, with corresponding value—all carried items have weight (it may be zero)

The above tables may be shortened, lengthened, subdivided to suit the game, but once established, may be used for many separate scenarios.

Environment Table

Each room, tunnel and cavern must be described. The contents of each, the position of items in the room described, so that when the room is entered, a description may be given to the player. A room may contain treasure, artifacts or monsters. Special events may occur upon certain actions, e.g. if a chest is opened, 3 goblins appear 3 turns later. Events may occur randomly at specific probabilities and triggered by other events. One environment table per scenario is required.

Current Environment Chart

A chart of the present environment needs to be kept. The states of all doors, traps and objects are kept, so that the player cannot strike an imaginery orc with a non-existent sword, when the room is exited that chart can be saved in the chronology log, such that if one room is re-entered, it will be as left.

Descriptions Table

This describes every object in the game. It may be very long (even filling a small disk!) If the player asks to DESCRIBE something, this table is searched, and the description displayed. (Alternatively a printed handbook may be kept)

In order to receive and understand input from the player, the program must apply some simple lexical analysis. This needs tables of recognised words:

Item Table

All items that may be referenced, such as weapons, treasure, creatures etc. (the original tables may be used).

Action Table

All possible actions, plus expected accompanying words or word types (e.g. where do you run? What, and with what do you hit?).

Direction Table

For movements up, down, north, onwards etc., To expand the vocabulary, several words may be grouped for one action (e.g. strike, hit etc.)

Responses Tables

Contain phrases and sentences to build up response to action command. The specific effect is coded for program use.

Great care must be taken as many words have several meanings.

The above suggestions for table break down are by no means a rigid or complete, but they indicate how tables may be used to create a total base for a fantasy game.

The program itself needs a beginning, a middle and an end. To start, the character and environment must be initialised, either by the program or the player. If the program is starting, a good description at the beginning of the player's surroundings and objectives is essential to give the player an initial injection of enthusiasm. e.g.

'You have just arrived high in the Andean Alps, in the ancient city of Ankaraputal. Here there is an old legend of fabulous wealth hidden deep in the catacombs. You have 3,000 Dengas with which to buy supplies from the local traders before you enter where no man has ever returned from. Even as you arrived, the sound of anguished howls, far away, meet your ears. You must tread warily. For unknown things guard the greatest treasure ever assembled through the long eons of time. Make your moves with care and short, active phrases—good luck, for you will need all your life can find . . .'

A player should be able to terminate a game at any time (e.g. by saying a magic word) and possibly re-enter the game at the same point at a later date—i.e. by restarting from the Chronology Log.

The adventure continues in a command for action and response until either the player terminates the session, achieves his goal(s) by a set degree, or is killed, captured etc.

The program may be divided into 3 parts:

(a) Analysis of command

(b) Formulation of response.

(c) File handling and searching—This is called by both (a) and (b)

Each part will now be considered in outline.

(a) Analysis of the input command includes:

(i) Finding the action by searching the action table with command words

(ii) If the action requires other words for clarification, searching the command for these, using the item/direction tables. Command types may be:

1. action.
2. action direction.
3. action item.
4. action item (preposition) item.

Examples of these are:

1. shout.
2. run north.
3. drop sword.
4. throw crystal ball at door.

Commands may be stacked using 'and':

drop sword and run north

If a command is incomplete, the remainder must be asked for e.g.:—

Player: run
Program: run where?

Special commands must be catered for, such as status request and termination requests.

If the command cannot be recognised, then the default response:

Nothing happens.

is given, and the return to command request made.

(b) Once the command has been recognised, the appropriate response is made using the Response Tables, coupled with the current Environment Table.

The feasability of the command must first be checked. If the player, for example, tries to use an item that he does not possess, then he may be prompted or penalised, similar options remain if the player makes an obviously foolhardy action (i.e. one that is not catered for). Thus the command:

Hit troll with feather

may either receive the reply:

Troll laughs

or

Troll becomes annoyed, and cleaves you in two.

The response, may be of several types:

(i) Relocation of player in a new environment, when a suitable command is given, spell is read etc.

(ii) Resolution of encounter with another creature. In an encounter, a player may:

1. Approach in a friendly manner.
2. Approach in a hostile manner (attack).
3. Approach in an indifferent manner (ignore).
4. retreat.

Each of these will trigger specified reactions as set in the Environment/Creature tables, modified by the player's basic characteristics, so a player with a high charisma will more probably persuade the creature to help.

If a combat situation ensues, the accuracy of blows, dodges etc., again depends upon the Creature and Environment Tables, and the player's characteristics. A combat turn is resolved first, by deciding whether a blow is made, and then how much damage is done.

(iii) Resolution of encounter with object, such as a booby-trapped treasure chest.

(iv) The allocation of rewards/penalties in the form of treasure, modifications to basic characteristics, etc., and such as the increase in wisdom when a trap is avoided or decrease in strength when wounded.

Factors which can affect a response must be considered, they include:—

1. time—an event may be triggered only within a given timespan.

2. certainty—an event than cannot be avoided.

3. interference—if certain precautions are not taken then an event will occur.

4. Warning—impending events may give warning signs, examples are:—

(i) A lamp burning out.

(ii) A roof collapse.

(iii) If sign is not read then the player is mugged (and treasure lost).

(iv) The sound of distant laughter, growing louder.

(c) Tables may be held in arrays or files. Arrays are memory based, and therefore limited. Files, held on disk provide much wider possibilities, and are more easily changed. Each table is made of records, and each record consists of a search element, plus fields relevent to that entry. e.g. a record in the Creature Table may be:

C12, Black Bat, 4, 20, 50, T5M

This is a Black Bat (referenced by C12), of strength 4 units. If it is approached, a random number from 1 to 100 is generated. If it is 20, or below the bat is friendly. If it is 21 to 50 then the bat is indifferent. If it is 51 to 100 then the bat attacks! A friendly bat will leave item T5 behind, as will a defeated bat, if mercy is shown.

What language should be used? For an extensive system using disk files, a language with a good record structure and file handling capabilities must rate highly. If you are lucky enough to have Pascal at your disposal, then it must be highly recommended. This does not exclude BASIC, in which many excellent games can, and have, been written. For packing most into a small space, and gaining faster running speed, if you have the time and inclination, an assembler program is always (potentially!) the most efficient.

This article has been an attempt at a broad outline of a workable fantasy game. It still requires much more work on it, but I believe it shows the possibilities that exist for worlds to escape into when the Klingons have all been driven away. Science fantasy is a long way from dead—a space game equivalent to this, with exploring strange new worlds and boldly going where no man has boldly gone since last week is potentially infinitely more complex than this—our game could be a small subsection of the ultimate universe game.

If you are interested in this type of game, get a copy of Dungeons and Dragons basic rules. There are many clubs that play it (often along with wargames) across the country, so try a game run by an organic computer!

Science fantasy fans might prefer the complexities of 'Traveller' a similar variety of a space theme.

Above all when you are programming games, remember, a good game leaves a player satisfied, but always ready for more escape into that realistic world that is a marriage of imagination and program generated fantasy.

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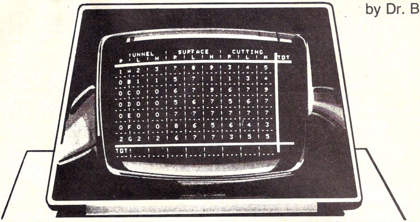

```
    TUNNEL    !  SURFACE  !  CUTTING
P ! L ! H ! R ! L ! H ! R ! L ! H  TOT
1 A 2 ! 3 ! 7 ! 8 ! 9 ! 3 ! 4 ! 5
0 B 1 ! 1 ! 5 ! 7 ! 1 ! 1 ! 3 ! 4
0 C 0 ! 0 ! 6 ! 7 ! 9 ! 6 ! 7 ! 9
0 D 0 ! 0 ! 5 ! 6 ! 7 ! 5 ! 6 ! 7
0 E 0 ! 0 ! 7 ! 7 ! 7 ! 7 ! 7 ! 7
0 F 0 ! 0 ! 8 ! 6 ! 5 ! 6 ! 4 ! 3
2 G 2 ! 2 ! 6 ! 7 ! 7 ! 3 ! 5 ! 5
TOT!   !   !   !   !   !   !   !
```

NUMERICAL ACCURACY OF MICROCOMPUTERS

INTRODUCTION

IF one studies the application made of microcomputers, these applications are in areas where frequently an Integer Basic is all that is needed (e.g. games, simulations or stock control). Applications for which we need to be concerned about figures accurate to seven, eight or more significant digits are few. As one of the principal concerns of main frame computer ('macrocomputer') users is with what might be termed 'statistical computing' software (e.g. SPSS, GLIM, GENSTAT and other acronymns), I have made an analysis of whether it is possible to perform some of these mystical rites on a microcomputer. My evaluation had to be concerned with two main questions:

(a) Was the storage necessary for multivariate statistical methods available with microcomputers?;
(b) Was the normal microcomputer accurate enough to be able to cope with a large amount of numerical calculations?

The answer to the first question was 'yes': storage was more than adequate in RAM and on disk for many microcomputers. The answer to (b) was a qualified 'yes': pretty accurate; not as accurate as handcoded BASIC on a typical macrocomputer; more accurate than macrocomputer BASIC using built-in functions; and compares well to an earlier generation of macrocomputers.

WORD LENGTHS AND ERROR ANALYSIS

If one takes a typical calculator, and enters a series of "1"s, one soon finds that only a set number of "1"s can be entered. In the case of the calculator I am using, the number in the display is "11111111", and I can key in as many other numbers as I care, but only these eight **significant digits** are recognized by the calculator. When the square root key is pressed the digits "3333.3333" are displayed and if this number is then squared the result is "11111110.". In an exact world the square of the square root of anumber is the same as the original number (e.g.: the square root of "4" is "2", and the square of "2" is "4"): in most computation the exact world does not fit. We have a 'rounding error'; that is, the square root of "11111111.' is a never ending series of digits of which the first eight are "333.333', and there is **never** any rounding-up. Technically, my calculator works with 'chopped' arithmetic (the trailing digits are chopped off).

Present macrocomputers do not usually work with chopped arithmetic, but work with what is termed 'rounded' arithmetic—the final significant digit depends upon the value of the following digit. Both forms of arithmetic produce errors, but with rounded arithmetic there is no consistent bias up or down, as there is with chopped arithmetic. For the ICI 1900 series (I used a 1902T in the comparisons below) each real number is held in two 24-bit words (48 bits in all). Of these 48 bits: 37 bits constitute the fixed point part (or mantissa) giving a relative accuracy of about eleven decimal digits (2^{37} is about 7×10^{12}); 9 bits constitute the exponent part, so that numbers can vary between about 10^{75} to 10^{76} in absolute size; and 2 bits are used for the signs of the two parts. (See Goult et al (1974: Ch 2) for more information; the key book is Forsythe & Moler (1967); and for definitions see Chandor (1977) but note that neither 'RAM', 'ROM' nor 'Microcomputer' appears in this latter publication.)

The 6502 processor (used, inter alia, by APPLE II, PET and ACORN) has a byte-based system of 8 bits per byte. Most of the development work for the comparisons below was performed in APPLESOFT BASIC (though they have been replicated on a PET), in which real numbers are held in five bytes (40 bits in all). Of these 40 bits: 30 bits hold the fixed-point part, giving a relative accuracy of about nine decimal digits (2^{30} is about 9×10^{10}); the exponent part is 8 bits long, so that numbers can vary from about 10^{38} to 10^{39}; and the 2 remaining bits hold the signs of the two parts. This would indicate that APPLESOFT BASIC has a high level of accuracy, but the **relative** accuracy of APPLESOFT BASIC compared to the SOBS BASIC on the 1902T is of the order of 1:128. Is this important?

TESTS OF ACCURACY—INVERSE HILBERT MATRICES

The impetus behind this examination is a multivariate statistical system being written for microcomputers (the Factor Analysis program is to be released in the early part of 1980): in multivariate analysis the most common mathematical procedure one uses, once one has a matrix of measures of association, is the inversion of a positive semi-definite matrix (those looking for a simple introduction to matrix algebra should try Branfield and Bell (1970), then chapter V from Noble (1966), and the more advanced reader can do no better than Forsythe and Moler (1967)).

For this reason I have developed a highly numerically accurate matrix elimination and decomposition set of routines, using Cholesky's method (to be discussed in more detail in the second paper in this series). The Cholesky routine was applied to test matrices with the coding in APPLESOFT BASIC (Apple II) and in SOBS BASIC (1902T)—in addition the built-in SOBS BASIC matrix routine 'MAT INV' routine seemed less stable.

Most of the matrices tested were well-behaved without an exactly known inverse and for this reason I decided to use inverse Hilbert matrices as test matrices (Forsythe & Moler, 1967: Ch 19). Hilbert matrices are **not** well-behaved (the technical term is 'ill-conditioned') in that small rounding errors have their effects maximized, but for reasons explained in Forsythe & Moler (1967: Ch 19) both the Hilbert matrix and its inverse are known exactly. Hilbert matrices can be of any order from 2 x 2 upwards: the Cholesky routines in APPLESOFT BASIC and SOBS BASIC were tested for Hilbert matrices from 2 x 2 to 10 x 10, together with the SOBS 'MAT INV' routine, (PETS BASIC gave identical results to APPLESOFT BASIC). (The Cholesky routine is a 'pseudo-inverse' routine, in which zero pivots are accommodated.)

To give a feel for what is meant by an 'ill-conditioned' system consider this pair of simultaneous equations:

$$100X + 99y = 199$$
$$99X + 98y = 197$$

where the exact solution is $X = 1$ and $y = 1$. Suppose that for some reason (e.g. it was an initial estimate) X was estimated to be 3, which led to the estimate $y = -1.020202$ on a calculator with 8 significant (chopped) digits. This produces

$$100X + 99y = 199.00001$$
$$99X + 98y = 197.02021$$

Differences of such magnitude (about 2 units) in X and Y only produce a relative error of .01025% in the second equation; in the first equation the relative error .00001/199 x 100% is identically equal to zero on my calculator. This is an 'ill-conditioned' system and the 'condition number' is approximately 3.96×10^4 to reflect this.

LARGEST ERRORS IN HILBERT MATRICES

Order	Condition Number	SOBS Error	APPLESOFT Error
2 x 2	1.20×10^{1}	0 (1)	0
3 x 3	1.92×10^{2}	0	0
4 x 4	6.48×10^{3}	0	0
6 x 6	1.79×10^{5}	0	2.5×10^{5}
6 x 6	4.41×10^{6}	1.0×10^{6}	5.8×10^{4}
7 x 7	1.33×10^{8}	9.0×10^{6}	1.6×10^{2}
8 x 8	4.25×10^{9}	5.1×10^{4}	*(2)
9 x 9	1.22×10^{11}	4.7×10^{3}	*
10 x 10	3.48×10^{12}	2.0×10^{2}	*

Notes: (1) The SOBS BASIC routine 'MAT INV' would not even invert the 2 x 2 inverse Hilbert matrix; (2) At this order and greater the routine detected zero pivots and thus did not give an inverse, but rather a pseudo inverse.

Table 1 shows the largest error in calculating the Hilbert matrix of different orders for SOBS BASIC and APPLESOFT BASIC versions of the Cholesky routine. The condition number is shown for each matrix, and it can be seen that beyond a 4 x 4 Hilbert matrix we have systems which are even more unstable than our example.

From an examination of this table one can see: the APPLESOFT BASIC Cholesky routine is remarkably accurate upto and including the 6 x 6 matrix (this matrix has a **very large** condition number); the SOBS BASIC Cholesky routine is highly accurate up to and including the 8 x 8 matrix; and the poorness of the supplied SOBS BASIC inversion routine ('MAT INV') is indicated by the fact that it could not invert the 2 x 2 matrix.

Incidentally, a 6 x 6 Hilbert Matrix is given in full in Forsythe & Moler (1967:82) and their largest error is 1.9×10^{4} calculated on an earlier macrocomputer, the IBM 7090 this is of the same order of magnitude as the APPLESOFT BASIC error.

CONCLUSIONS

It would seem that, if we are careful with the computational efficiency of our numerical routines, we are able to guarantee a fair degree of numerical accuracy in our results on at least one microcomputer, APPLE II. What is equally interesting (yet not as important) is that present microcomputers are about as accurate as many of the 60s and early 70s macrocomputers. (Though the implementation of 'SQR' in APPLESOFT BASIC may not be as efficient as it might be).

The next article in this series will discuss matrix inversion routines in BASIC for microcomputers.

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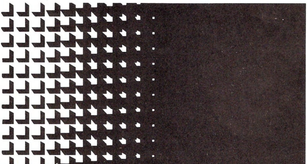

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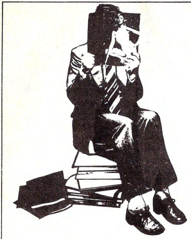


CESIL an introduction

D. Straker

CESIL is a very simple language devised by ICL as an introduction to low level programming for school children, hence the name: Computer Education in Schools Instructional Language. As it is uncomplicated by hexadecimal, index registers two's complement etc. it can also serve admirably as an introduction for anyone curious about the vagaries of assembler Languages.

It also provides an excellent example for a programmer who wants to write a Compiler/Interpreter. This article is thus written for as wide a readership as possible, so complex terminology has not been used, and many concepts have been considerably simplified. Stack pointers, program counters and addressing modes are all ignored—the only register (or 'special' memory location) considered is the *accumulator,* with respect to which, all operations are carried out. All operations are on signed integer data—text handling is not included in CESIL. Each memory location holds one signed integer.

The CESIL instruction line is separated into 3 district parts, each written in a separate column:

```
LABEL     INSTRUCTION     OPERAND
```

(a) LABEL—the label is optional, and is, as it says, a label, used by other instructions to refer to this line (like the line number in BASIC)

(b) INSTRUCTION—the instruction indicates what this line is to perform, e.g. ADD, STORE etc.

(c) OPERAND—the operand indicates which memory locations or integers the instruction is to act upon

The label and memory location names are restricted to six characters or less. The first must be alphabetic, the others alphanumeric, so FRED and A1 are legal and 1D and JIM* are illegal.

Input and output is always to and from the accumulator. Input is from a data list, given at the end of the program listing, into the accumulator, so

```
IN
```

will read the next number in the data list into the accumulator (like READ and DATA in BASIC). Conversely, the instruction

```
OUT
```

will print the number in the accumulator on to the terminal (like PRINT in BASIC)
Note: these two instructions have no operands

Moving numbers between the accumulator and memory is done with STORE and LOAD instructions:

```
STORE     AREA
```

will copy the number in the accumulator into the memory location and named AREA, and

```
LOAD     GREY
```

will copy the number in memory location GREY into the accumulator. Signed numbers can also be loaded, so

```
LOAD     +2
```

will move the number 2 into the accumulator. Note that the sign (+ or −) on the number is required. Loading numbers like this is called loading *immediate* data.

Arithmetic is all integer, as no decimal numbers are allowed in CESIL. The standard four functions are available. Operands may be immediate data or named memory locations. The answer to all arithmetic operations is put in the accumulator, so

```
ADD     LENGTH
```

adds the number in location LENGTH to the accumulator.

```
SUBTRACT   + 2
```

subtract 2 (ie adds 2) from the accumulator

```
MULTIPLY   + 12
```

multiplies the number in the accumulator by 12.

```
DIVIDE AREA
```

divides the number in the accumulator by the number in memory location AREA. The remainder is ignored. Jumps in the programs are always to a labelled line elsewhere in the program (like GOTO in BASIC), so

```
JUMP    LINES
```

causes a jump to the line with label LINES. There are two indicators or 'flags' in CESIL, which at all times reflect the 'condition' of the number currently in the accumulator. These are the negative and zero flags, and a conditional jump is available upon each, so

```
JIZERO   RERUN
```

causes a jump to line labelled RERUN *only* if the zero flag is set, i.e. the number in the accumulator is zero, and

```
JINEG B40
```

causes a jump to line labelled B40 *only* if the negative flag is set, i.e. the number in the accumulator is zero. The last instruction may be used anywhere, but is commonly the last in the program listing. It stops the program running, as END in BASIC:

```
HALT
```

These 12 instructions are all there is to CESIL. They are summarised in Table 1. Note that all instructions can (and commonly are) abbreviated to the first three letters. Programs can now be written in CESIL, and an example is given in Fig 1.

When assembler listings are seen, they always have these three columns (although occasionally they are crushed together, which is very bad practice). Sometimes there are also numbers on the left and comments on the right of the listings. These can be explained using an extension to CESIL as a model: comments to the right are just that—comments, put in a fourth column, to help anyone else reading the program understand its functions (like REM in BASIC).

As the program itself is held in memory, to simplify things for the processor, instructions are held as coded numbers called op-codes (see Table 1). Locations used for storing numbers are reserved at the beginning of the program using the NUM(BER) command in the instruction column (note this is not a true instruction to the processor, but a command to the assembler). Any reference to a location is then made to the displacement, or offset of the location from the start of the program, so:

```
01  00      NUM   FIRST
02  00      NUM   SECOND
```

```
07  03 01   LOA     FIRST  CODE STARTS HERE
09  11 13   JIZ     NEXT
11  05 05   ADD     +5      ONLY IF FIRST<>0
13  02      NEXT    out  =
```

may be described thus:

the lefthand column of numbers is a count not of lines, but of memory locations since the start of the program. The other numbers are actually how the program is held in memory ready for processing.

The first two lines reserve two memory locations, calling them FIRST and SECOND, and initialises them to zero.

Later in the program, at the seventh location, the op-code of 03 indicates LOAD, and 01 indicate to load from the first location past the start of the program.

On the next line 11 indicates the JIZERO instruction, and the label is indicated by where in memory to jump to, i.e. the 13th location past the start of the program.

Immediate data is held as the signed integer as indicated in the next line.

This format is the author's extension which may be used to extend the idea of CESIL to help to explain assembler listings.

Another example is given in Fig 2.

CESIL has many critics (as does BASIC!), but its extreme simplicity has proved in many cases to be a good introduction to low level programming. It can open the door to the amazingly versatile world of Assembly programming to many people who would otherwise take one look and pass it by as 'an unintelligible load of letters and numbers'.

Table 1 CESIL SUMMARY

Instruction	Abbrev.	Operation	Opcode
IN	IN	Acc ← next in data list	01
OUT	OUT	Terminal ← Acc	02
LOAD	LOA	Acc ← nm	03
STORE	STO	m ← Acc	04
ADD	ADD	Acc ← Acc + nm	05
SUBTRACT	SUB	Acc ← Acc—nm	06
MULTIPLY	MUL	Acc ← Acc x nm	07
DIVIDE	DIV	Acc ← Acc ÷ nm	08
JUMP	JUM	Jump to m	09
JINEG	JIN	Jump to l if Acc = 0	10
JIZERO	JIZ	Jump to l if Acc ≠ 0	11
HALT	HAL	stop execution	12

Key: Acc accumulator

becomes equal to

nm operand immediate data or memory location

m operand memory location

l label

Fig 1

CESIL example to find the average of the 5 numbers:
12, 13, 7, 2, -9

```
        LOA        + 0
        STO      TOTAL
        LOA        + 5
NEXT    STO      COUNT
        IN
        ADD      TOTAL
        STO      TOTAL
        LOA      COUNT
        SUB        + 1
        JIZ        END
        JUM       NEXT
END     LOA      TOTAL
        OUT
        HAL
Data List: 12 13 7 2 -9
```

Fig 2

Extended CESIL example to find the remainder after 127 is divided by 13

```
01  00      NUM   NUMBER
02  00      NUM   DIVBY
03  01      IN                     GET DIVIDEND
04  04  01  STO   NUMBER
06  01      IN                     GET DIVISOR
07  04  02  STO   DIVBY
09  03  01  LOA   NUMBER    START
                            CALCULATIONS
11  08  02  DIV   DIVBY     NOTE INTEGER
                                  RESULT
13  07  02  MUL   DIVBY
15  06  01  SUB   NUMBER
17  07  -1  MUL   -1
19  02      0UT                PRINT RESULT
20  12      HAL

data list will
be put here
```

ACORN and the KIM 1

W. H. Powell

THE ACORN has much in common with KIM-1. It has the same 1¼ kbyte RAM and uses the same CPU (6502 used by PET, APPLE, and Superboard). Both ACORN and KIM have calculator style displays and keyboards with an operating system in ROM that makes them good low cost tools on which to learn machine code programming for the 6502. Both provide tape interfaces for storing and reloading programs.

These similarities suggest running KIM software on ACORN. The author soon found that although the ACORN display routine is better than KIM, it is easier to run KIM software by writing routines for ACORN which make it behave like KIMs keyboard/display.

On KIM one has access to a routine (SCANDS) which scans the display once, and another (GETKEY) which scans the keys to see if one is depressed. To light the display steadily, one puts SCANDS in a program loop to keep scanning faster than the eye can see. Similarly, some pretty programming is necessary to make GETKEY debounce the keys. The programmes in the FIRST BOOK OF KIM show how to do this, and also how to manipulate the display for various games. A typical KIM key/display program contains:

```
START  JSR   SCANDS   Light Display
       JSR   GETKEY   Read keyboard
       CMP   PREV     Same key as last time?
       BEQ   START    Else continue . . .
```

The ACORN monitor does all this for you, but in spite of this I have found it much easier to run KIM programmes by using routines that run like SCANDS etc so that the KIM software need be changed as little as possible. Fig 1 gives my programme for simulating KIM, and the SUMMARY TABLE lists the differences in mnemonics and locations for the two machines.

e.g.

```
         20 1F 1F  JSR SCANDS on KIM
becomes  20 AB OE  JSR SCANDS on ACORN
```

There are other points of note; the control keys on both KIM and ACORN return Hex values above 0F. Section 1 of the table shows the labeling and Hex values for these keys on each machine.

The I/O ports used for the calculator style display and keyboard are at different addresses and must be initialised to different values. These are summarised in sections 2 and 4 of the table. Section 3 lists the most common KIM pointers held on page zero.

KIM uses six digits which it numbers strangely 09 0B 0D 0F 11 and 13. The routine CONVD corrects this to the simpler ACORN numbering 0 1 2 3 4 5 (digits 6 and 7 are not required).

In order to make KIM software run on ACORN one first loads the programme in Fig 1 into the 128 bytes of RAM in the I/O port. Then one edits the KIM subroutine jumps and data direction ports by referring to the addresses in the TABLE.

One difficulty may remain . . . the lack of a timer on ACORN. In most cases one can get around this problem. The first use for KIM's timer is to pause during execution. This can be done equally well without a timer by using a random number for games etc. The location 'TIMER' in Section 4 of the table acts as a source of random numbers for ACORN. The third use is to actually measure time while the CPU is running some other software. This really does need a timer, and the basic ACORN must be extended to run such programmes.

Fig 2 and 3 are Hex dumps of programs from FIRST BOOK OF KIM modified to run on ACORN. The changes to HI-LO (Fig 2) are straightforward, but the changes in ASTEROID (Fig 3) are more elaborate.

The different display routines are not the only differences bytween KIM and ACORN. The KIM monitor is much bigger (2 kybte), and includes TTY routines as well as those for a calculator type display discussed above. Physically KIM is on a large single board whereas ACORN is in two neat Eurocards one of which , the CPU card, is clearly intended for building into other equipment. For this reason it carries a socket for

EPROM (1, 2 or even 4 kbytes with a suitable device) which could allow it to act as a stand alone controller. The CPU board is also easier to expand to fully memory since only the top and bottom 4 kbytes have been allocated to CPU card memory and I/O ports. Unlike KIM there are no assumptions about the remaining 56 Kbyte making it much easier to expand ACORN in a modualr manner. On the other hand KIM has an established range of extensions already. One of the most interesting is MEMORY-PLUS which carries an EPROM programmer as well as sockets for ROM and RAM.

SUMMARY TABLE of KIM Display Routines for ACORN

1 Keys

KIM	Key	ACORN
AD	10	M
DA	11	G
+	12	P
GO	13	S
PC	14	L
No Key	15	R
–	16	↑
–	17	↓

2 Data Directions

	KIM	ACORN
Data	#7F	# 07
Location	PADD = 1741	ADDR = 0E22

For ACORN, this can be left in this state for reading keyboard. But KIM requires 0 0 → PADD to read keys.

3 Page Zero

POINTL = FA	INL = F8	Input Buffer
POINTH = FB	INH = F9	Input Buffer
TEMP = FC		

These are same for KIM/ACORN simulation of KIM.

4 Display/Keyboard Routines

KIM	Routine	ACORN	
1704	"TIMER"	0EFF	Generates Random numbers during KEY PR
1F19	SCAND	0EA5	Display address & contents.
1F1F	SCANDS	0EAB	Display 6 Hex digits.
1F40	KEY PR etc.	0ECD	Test Keyboard for any key.
1F6A	GETKEY	0ED8	Test which key pressed.
* 1F48	CONVD	0E80	Display 1 Hex digit.
1F4E	CONVD+6	0E86	Display 1 digit 7 segment pattern.
1F63	INCPT	0E9B	Increment display address
1FE7	TABLE	FFEA	Table of 7 segment patterns.

* These require 07 → ADDR < = 0E22 > on ACORN
instead of 7F → PADD < =1741 > on KIM

* 1742	SBD → 0E20 (Part A)	Digit drive	
1740	SAD → 0E21 (Part B)	Segment drive on ACORN/KIM	

KIM digit numbers	09,	0B,	0D,	0F,	11,	13	
ACORN digit numbers	00,	01,	02,	03,	04,	05. –	six digits.

Fig 1 Subroutine : CONVD (1F48)

This converts one Hex digit to 7 Segment and shows it.

```
0E80  84FC Convd.      STY Temp.       Save Y
   2  A8               TAY         ⎫   Get 7 segment
   3  B9 EA FF         LDA Table,Y ⎬   pattern and send
   6  8D 21 0E ─┐                  ⎪   to
      └> Convd +6      STA Segmen  ⎭   display
   9  8A               TXA    ⎫        Change X to
   A  4A               LSRA   ⎬        value for ACORN
   B  38               SEC    ⎭
   C  E9 04            SBC   04
   E  8D 20 0E         STA Port A      Light display
0E91  A0 7F            LDY←┐7F   ⎫
   3  88        Delay  DEY ┘     ⎬     Delay
   4  D0 FD            BNE Delay ⎭
   6  E8 E8            INX INX         Next digit.
   8  A4 FC            LDY Temp        Restore Y
   A  60               RTS.
```

Subroutine : INCPT

```
0E9B  E6FA        Inept     INC  Pointh
   D  D0 02              ┌──BNE  Inept 2
   F  E6 FB              │  INC  Pointh
0EA1  60          Inept2 └─>RTS
  A2  EA EA EA              NOP
```

Fig 1 (continued)

Routine SCAND (1F19)

Output to display

```
0EA5  A0 0 0 Scand    LDY# 0 0        Get data pointed to
   7  B1 FA           LDA (Pointh),Y into display buffer.
   9  85 F9           STA Inh

   B  A9 07 Scands    LDA# 07         Set scan lines
   D  8D 22 0E        STA Addr (PADD)
0EB0  A2 09           LDX# 09         Initialise digit zero
   2  A0 03           LDY# 03         3 bytes to display

   4  B9 F8 00 Scand1 ┌─>LDA Int,Y        Get Byte
   7  4A 4A           │  LSRA LSRA ⎫     ready for
   9  4A 4A           │  LSRA LSRA ⎭     M.S.D.
   B  20 80 0E        │  JSR Convd.        display it;
   E  B9 F8 00        │  LDA Int, Y.       Get Byte back.
0EC1  29 0F           │  AND   0F          Ready for LSD.
   3  20 80 0E        │  JSR Convd.
   6  88              │  DEY
   7  D0 EB           └──BNE Scand 1.
   9  8C 21 0E           STY Segmen
   C  EA                 NOP
```

Kim 'AK' (IEFE) and 'KEY PR' (1F40)

```
Returns 'A' = 00 if no key is pressed.
        'A' ≠ 00 if key is pressed.

0ECD  EE FF 0E Key pr INC  "TIMER"
  D0  20 E5 0E        JSR Keyfind.
   3  90 02           BCC ─┐ Exit  Key was found: A ≠ 00
   5  A9 00           LDA  │ #00   no key ∴ 'A' ← 00
   7  60       Exit   RTS ◄┘
```

Fig 1 (continued)

KIM 'GETKEY' (1F6A)

```
Returns 'A' = key if a key is pressed.
        'A' = $15 if no key is pressed.

0ED8  20 E5 0E  Getkey JSR  Keyfind.
   B  B0 05            BCS  No key
   D  49 38            EDR  # 38 Make binary
   F  29 1F            AND  #1F
0EE1  60               RTS
   2  A9 15            LDA  #15 Return $15 for
                                      no key.
   4  60               RTS
```

Subroutine 'Keyfind' (New)

```
0EE5  A0  00          Keyfind LDY # 00      ⎫ Turn display
   7  8C  21  0E              STY Segmen    ⎬     off
                                 (Part B)   ⎭

   A  A2  07                  LDX # 07      ⎫ set seam
   C  8E  22  0E              STX ADDR      ⎬   lines
                                 (ie PADD)  ⎭

   F  8E  20  0E  Seam        STX Part A    ⎫ Read keyboard
0EF 2 AD  20  0E              LDA Part A    ⎭   at 'X'
   5  29  3F                  AND # 3F        Remove top bits.
   7  C9  38                  CMP # 38        Are we pressing
                                                 a key?
   9  90  03                  BCC ─┐ Exit     Yes we are.
   B  CA                      DEX  │
   C  10  F1                  BPL  │ Seam     More scans to do.
   E  60          Exit        RTS ◄┘          Carry clear if
                                                 key found.
```

```
:::::::: HEX DUMP - ASTEROID ::::::::

0200-   A9 00 85 F9 85 FA 85 FB A2 06 BD CE 02 95 E2 CA
0210-   10 F8 A5 E8 49 FF 85 E8 A2 05 20 48 02 20 97 02
0220-   CA D0 F7 20 40 1F 20 6A 1F C9 15 10 E5 C9 00 F0
0230-   06 C9 03 F0 0A D0 DB 06 E7 A9 40 C5 E7 D0 D3 46
0240-   E7 D0 CF 38 26 E7 D0 CA A9 7F 8D 41 17 A9 09 8D
0250-   42 17 A9 20 85 E0 A0 02 A9 00 85 E1 B1 E2 25 E0
0260-   F0 07 A5 E1 19 E4 00 85 E1 88 10 F0 A5 E1 C4 E8
0270-   D0 08 A4 E0 C4 E7 D0 02 09 08 8D 40 17 A9 30 8D
0280-   06 17 AD 07 17 F0 FB A9 00 8D 40 17 EE 42 17 EE
0290-   42 17 46 E0 D0 C0 60 C6 E9 D0 1A A9 30 85 E9 8A
02A0-   48 A2 FD F8 38 B5 FC 69 00 95 FC E8 D0 F7 D8 68
02B0-   AA E6 E2 A5 E2 C9 30 F0 09 A0 00 A5 E7 31 E2 D0
02C0-   07 60 A9 00 85 E2 F0 F1 20 1F 1F 4C C8 02 D5 02
02D0-   08 40 01 04 FF 00 00 00 04 00 08 00 06 12 00 11
02E0-   00 05 00 2C 00 16 00 29 00 16 00 2B 00 26 00 19
02F0-   00 17 00 38 00 2E 00 09 00 1B 00 24 00 15 00 39
0300-   00 0D 00 21 00 10 00 00
```

```
ACORN   (Modifications)

0220-   CA D0 F7 20 D0 0E 20 D8 0E etc
0240-   ......................CA A9 07 8D 22 0E A9 00 8D
0250-   20 0E etc
0270-   ...........................03 8D 21 0E A9 C0 8D
0280-   21 00 CE 21 00 A5 21 D0 F7 8D 21 0E EE 20 0E EA
0290-   EA EA 46 E0 etc
02C0-   ......................F1 20 AB 0E ...etc
```

Fig 3 ASTEROID for KIM and ACORN

```
:::::::: HEX DUMP - HI LO ::::::::

KIM

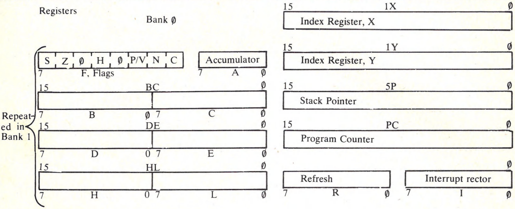
0200 F8 A5 E0 38 69 00 A2 01 C9 99 D0 01 8A 85 E0 20
0210 40 1F D0 ED D8 A9 99 85 FB A9 00 85 FA A2 A0 86
0220 F9 86 E1 20 1F 1F 20 6A 1F C9 13 F0 D3 C5 E2 F0
0230 F2 85 E2 C9 0A F0 10 B0 EA 0A 0A 0A 0A A2 03 0A
0240 26 F9 CA 10 FA 30 DC A5 F9 C5 E0 90 06 C5 FB B0
0250 D2 85 FB A6 E0 E4 F9 90 08 A6 FA E4 F9 B0 C4 85
0260 FA A6 E1 E8 E0 AA F0 B5 D0 B5
```

```
ACORN

0210 D0 0E etc
0220 F9 86 E1 20 AB 0E 20 D8 0E etc
```

Fig 2 The game HI-LO for KIM and ACORN

Z-80 Processor Profile


Registers
Bank 0
S Z 0 H 0 P/V N C
7 F, Flags
Accumulator
7 A 0
15 BC 0
7 B 0 7 C 0
15 DE 0
7 D 0 7 E 0
15 HL 0
7 H 0 7 L 0
Repeated in Bank 1
15 1X 0
Index Register, X
15 1Y 0
Index Register, Y
15 5P 0
Stack Pointer
15 PC 0
Program Counter
0
Refresh
7 R 0
Interrupt rector
7 I 0

MAIN Z80 CODES   Note: dsp, dd, port, codes followed by 1 byte; addr, (addr), codes followed by 2 bytes

H1 / H2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NOP	DJNZ ,dsp	JR NZ,dsp	JR NC,dsp	LD B,B	LD D,B	LD H,B	LD (HL),B	ADD A,B	SUB B	AND B	OR B	RET NZ	RET NC	RET PO	RET P
1	LD BC,dddd	LD DE,dddd	LD HL,dddd	LD SP,dddd	LD B,C	LD D,C	LD H,C	LD (HL),C	ADD A,C	SUB C	AND C	OR C	POP BC	POP DE	POP HL	POP AF
2	LD (BC),A	LD (DE),A	LD (addr),HL	LD (addr),A	LD B,D	LD D,D	LD H,D	LD (HL),D	ADD A,D	SUB D	AND D	OR D	JP NZ,addr	JP NC,addr	JP PO,addr	JP P,addr
3	INC BC	INC DE	INC HL	INC SP	LD B,E	LD D,E	LD H,E	LD (HL),E	ADD A,E	SUB E	AND E	OR E	JP addr	OUT port,A	EX (SP),HL	DI
4	INC B	INC D	INC H	INC (HL)	LD B,H	LD D,H	LD H,H	LD (HL),H	ADD A,H	SUB H	AND H	OR H	CALL NZ,addr	CALL NC,addr	CALL PO,addr	CALL P,addr
5	DEC B	DEC D	DEC H	DEC (HL)	LD B,L	LD D,L	LD H,L	LD (HL),L	ADD A,L	SUB L	AND L	OR L	PUSH BC	PUSH DE	PUSH HL	PUSH AF
6	LD B,dd	LD D,dd	LD H,dd	LD (HL),dd	LD B,(HL)	LD D,(HL)	LD H,(HL)	HALT	ADD A,(HL)	SUB (HL)	AND (HL)	OR (HL)	ADD A,dd	SUB dd	AND dd	OR dd
7	RLCA	RLA	DAA	SCF	LD B,A	LD D,A	LD H,A	LD (HL),A	ADD A,A	SUB A	AND A	OR A	RST 00	RST 10	RST 20	RST 30
8	EX AF,AF'	JR dsp	JR Z,dsp	JR C,dsp	LD C,B	LD E,B	LD L,B	LD A,B	ADC A,B	SBC A,B	XOR B	CP B	RET Z	RET C	RET PE	RET M
9	ADD HL,BC	ADD HL,DE	ADD HL,HL	ADD HL,SP	LD C,C	LD E,C	LD L,C	LD A,C	ADC A,C	SBC A,C	XOR C	CP C	RET	EXX	JP (HL)	LD SP,HL
A	LD A,(BC)	LD A,(DE)	LD HL,(addr)	LD A,(addr)	LD C,D	LD E,D	LD L,D	LD A,D	ADC A,D	SBC A,D	XOR D	CP D	JP Z,addr	JP C,addr	JP PE,addr	JP M,addr
B	DEC BC	DEC DE	DEC HL	DEC SP	LD C,E	LD E,E	LD L,E	LD A,E	ADC A,E	SBC A,E	XOR E	CP E	see CB chart	IN A,port	EX DE,HL	EI
C	INC C	INC E	INC L	INC A	LD C,H	LD E,H	LD L,H	LD A,H	ADC A,H	SBC A,H	XOR H	CP H	CALL Z,addr	CALL C,addr	CALL PE,addr	CALL M,addr
D	DEC C	DEC E	DEC L	DEC A	LD C,L	LD E,L	LD L,L	LD A,L	ADC A,L	SBC A,L	XOR L	CP L	CALL addr	see notes	see ED chart	see notes
E	LD C,dd	LD E,dd	LD L,dd	LD A,dd	LD C,(HL)	LD E,(HL)	LD L,(HL)	LD A,(HL)	ADC A,(HL)	SBC A,(HL)	XOR (HL)	CP (HL)	ADC A,dd	SBC A,dd	XOR dd	CP dd
F	RRCA	RRA	CPL	CCF	LD C,A	LD E,A	LD L,A	LD A,A	ADC A,A	SBC A,A	XOR A	CP A	RST 08	RST 18	RST 28	RST 38

CB CODES

H1 H2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0					BIT 0,B	BIT 2,B	BIT 4,B	BIT 6,B	RES 0,B	RES 2,B	RES 4,B	RES 6,B	SET 0,B	SET 2,B	SET 4,B	SET 6,B
1					BIT 0,C	BIT 2,C	BIT 4,C	BIT 6,C	RES 0,C	RES 2,C	RES 4,C	RES 6,C	SET 0,C	SET 2,C	SET 4,C	SET 6,C
2					BIT 0,D	BIT 2,D	BIT 4,D	BIT 6,D	RES 0,D	RES 2,D	RES 4,D	RES 6,D	SET 0,D	SET 2,D	SET 4,D	SET 6,D
3					BIT 0,E	BIT 2,E	BIT 4,E	BIT 6,E	RES 0,E	RES 2,E	RES 4,E	RES 6,E	SET 0,E	SET 2,E	SET 4,E	SET 6,E
4					BIT 0,H	BIT 2,H	BIT 4,H	BIT 6,H	RES 0,H	RES 2,H	RES 4,H	RES 6,H	SET 0,H	SET 2,H	SET 4,H	SET 6,H
5					BIT 0,L	BIT 2,L	BIT 4,L	BIT 6,L	RES 0,L	RES 2,L	RES 4,L	RES 6,L	SET 0,L	SET 2,L	SET 4,L	SET 6,L
6					BIT 0,(HL)	BIT 2,(HL)	BIT 4,(HL)	BIT 6,(HL)	RES 0,(HL)	RES 2,(HL)	RES 4,(HL)	RES 6,(HL)	SET 0,(HL)	SET 2,(HL)	SET 4,(HL)	SET 6,(HL)
7					BIT 0,A	BIT 2,A	BIT 4,A	BIT 6,A	RES 0,A	RES 2,A	RES 4,A	RES 6,A	SET 0,A	SET 2,A	SET 4,A	SET 6,A
8					BIT 1,B	BIT 3,B	BIT 5,B	BIT 7,B	RES 1,B	RES 3,B	RES 5,B	RES 7,B	SET 1,B	SET 3,B	SET 5,B	SET 7,B
9					BIT 1,C	BIT 3,C	BIT 5,C	BIT 7,C	RES 1,C	RES 3,C	RES 5,C	RES 7,C	SET 1,C	SET 3,C	SET 5,C	SET 7,C
A					BIT 1,D	BIT 3,D	BIT 5,D	BIT 7,D	RES 1,D	RES 3,D	RES 5,D	RES 7,D	SET 1,D	SET 3,D	SET 5,D	SET 7,D
B					BIT 1,E	BIT 3,E	BIT 5,E	BIT 7,E	RES 1,E	RES 3,E	RES 5,E	RES 7,E	SET 1,E	SET 3,E	SET 5,E	SET 7,E
C					BIT 1,H	BIT 3,H	BIT 5,H	BIT 7,H	RES 1,H	RES 3,H	RES 5,H	RES 7,H	SET 1,H	SET 3,H	SET 5,H	SET 7,H
D					BIT 1,L	BIT 3,L	BIT 5,L	BIT 7,L	RES 1,L	RES 3,L	RES 5,L	RES 7,L	SET 1,L	SET 3,L	SET 5,L	SET 7,L
E					BIT 1,(HL)	BIT 3,(HL)	BIT 5,(HL)	BIT 7,(HL)	RES 1,(HL)	RES 3,(HL)	RES 5,(HL)	RES 7,(HL)	SET 1,(HL)	SET 3,(HL)	SET 5,(HL)	SET 7,(HL)
F					BIT 1,A	BIT 3,A	BIT 5,A	BIT 7,A	RES 1,A	RES 3,A	RES 5,A	RES 7,A	SET 1,A	SET 3,A	SET 5,A	SET 7,A

ED CODES

H1 H2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0					IN B,(C)	IN D,(C)	IN H,(C)				LDI	LDIR				
1					OUT (C),B	OUT (C),D	OUT (C),H				CPI	CPIR				
2					SBC HL,BC	SBC HL,DE	SBC HL,HL	SBC HL,SP			INI	INIR				
3					LD (addr),BC	LD (addr),DE	LD (addr),HL	LD (addr),SP			OUTI	OTIR				
4					NEG											
5					RETN											
6					IM 0	IM 1	~~IM 2~~									
7					LD I,A	LD A,I	RRD									
8					IN C,(C)	IN E,(C)	IN L,(C)	IN A,(C)			LDD	LDDR				
9					OUT (C),C	OUT (C),E	OUT (C),L	OUT (C),A			CPD	CPDR				
A					ADC HL,BC	ADC HL,DE	ADC HL,HL	ADC HL,SP			IND	INDR				
B					LD BC,(addr)	LD DE,(addr)	LD HL,(addr)				OUTD	OTDR				
C																
D					RETI											
E						IM 2										
F					LD R,A	LD A,R	RLD									

REVAS & ZEAP

John Haigh

PARKINSON's Revas, the disassembler for Nascom recently serialised in Personal Computer World, produces an assembly listing from a section of machine code. A patch can be added to the routine which displays the assembly listing so that the output is simultaneously stored in the edit buffer of Zeap, the Nascom assembler. The disassembled program can then be edited, labelled, relocated and reassembled as required. The patch provides two start addresses for Revas. The normal start only sends the output to the VDU. When the 'Zeap' start is used, a test is first made to see if the Zeap edit buffer is empty; an ORG statement is inserted and a line number is entered at the beginning of each line.

Revas does not use standard Z80 mnemonics for some instructions. For example, ADD r is used in place of ADD A,r. Lines containing non-standard mnemonics will be rejected by Zeap on assembly and must be edited to the correct form.

```
8E61              0010   ESTRT     EQU £8E61            ;equates from Revas
8E87              0020   BUFF      EQU £8E87
1E0D              0030   EDBUFF    EQU£1B0D             ;from Zeap
0C0E              0040   ARG2      EQU £0C0E            ;from Nascom
0232              0050   TBCD3     EQU £0232
8E00              0060             CRG £8E00            ;normal start for
8E00    C39C8F    0070   NORMST    JP REPTCH            ;Revas in 32K system
8F00              0080             0RG £8F00            ;start for Revas
8F00    2A0D1B    0090   ZPSTRT    LD HL, (EDBUFF)      ;with Zeap
8F03    11111B    0100             LD DE, £1B11         ;compare value stored
8F06    B7        0110             OR A                 ;at £1B0D with
8F07    ED52      0120             SBC HL,DE            ;1B11
8F09    280F      0130             JR Z,ZSE-$           ;if equal, jump
8F0B    EF1E      0140             DEFB £EF,£1E         ;if unequal, Zeap
8FOD    5A..      0150             DEFM/Zeap error/     ;is not ready for
8F17    1F00      0160             DEFB £1F,00          ;the program
8F19    76 (CF)   0170             HALT(RST 8)          ; use RST 8 with T4
8F1A    21068E    0180   ZS1       LD HL, NORMST + 6    ;insert jump
8F1D    36C3      0190             LD (HL),£C3          ;instruction at £8E06
8F1F    215D8F    0200             LD HL, Z INPUT
8F22    22078E    0210             LD (NORMST + 7),HL
8F25    210100    0220             LD HL,1              ;line number one
8F28    22101B    0230             LD (£1B10),HL        ;enter in Zeap
8F2B    23        0240             INC HL
8F2C    22AA8F    0250             LD (LINENO),HL       ;initialise LINENO
8F2F    21121B    0260             LD HL,£1B12          ;start of first line
8F32    22180C    0270             LD (£0C18), HL       ;reset cursor
8F35    060C      0280             LD B,£0C             ;clear space to remove
8F37    3620      0290             LD (HL),£20          ;zeros, which interfere
```

```
8F39   2C          0300            INC L                ;with cursor routine
8F3A   10FB        0310            DJNZ-3
8F3C   EF          0320            RST 40
8F3D   20,...      0330            DEFM/0RG £/
8F43   00          0340            NOP
8F44   2A0E0C      0350            LD HL, (ARG2)        ;get start address
8F47   CD3202      0360            CALL TBCD3           ;put in CRG line
8F4A   2A180C      0370            LD HL, (£0C18)       ;mark end of line
8F4D   2B          0380            DEC HL               ;with zero and £FF
8F4E   3600        0390            LD (HL),0
8F50   23          0400            INC HL
8F51   36FF        0410            LD (HI),-1
8F53   23          0420            INC HL               ;start of free memory
8F54   220D1B      0430            LD (EDBUFF),HL       ;store in EDBUFF
8F57   EF1F00      0440            DEFB £EF,£1F,00      ;new line resets cursor
8F5A   C3618E      0450            JP ESTRT             ;start disassemby
8F5D   D5          0460  ZINPUT    PUSH DE              ;this routine copies
8F5E   21AA8F      0470            LD HL, LINENO        ;one line from Revas
8F61   ED5B0D1B    0480            LD DE,(EDBUFF)       ;to Zeap buffer
8F65   1B          0490            DEC DE
8F66   7E          0500            LD A, (HL)           ;enter line number
8F67   12          0510            LD (DE),A
8F68   C601        0520            ADD A,1              ;increment line number
8F6A   27          0530            DAA                  ;convert to decimal
8F6B   77          0540            LD (HL),A
8F6C   23          0550            INC HL               ;get next digits of
8F     13          0560            INC DE               ;line number
8F6E   7E          0570            LD A,(HL)
8F6F   12          0580            LD (DE),A
8F70   3004        0590            JR NC,ZT1-$          ;jump if no carry
8F72   C601        0600            ADD A,1              ;add carry to upper
8F74   27          0610            DAA                  ;digits
8F75   77          0620            LD (HL),A
8F76   21A18E      0630  ZT1       LD HL,BUFF+26        ;start of line in
8F79   7E          0640  ZT2       LD A,(HL)            ;Revas buffer
8F7A   23          0650            INC HL               ;copy line to
8F7B   13          0660  ZT3       INC DE               ;Zeap until a space
8F7C   12          0670            LD (DE),A            ;is encountered
8F7D   FE20        0680            CP £20
8F7F   20F8        0690            JR NZ,ZT2-$
8F81   7E          0700  ZT4       LD A,(HL)            ;skip consecutive
8F82   23          0710            INC HL               ;spaces until next
8F83   FE20        0720            CP £20               ;non-space character
8F85   28FA        0730            JR Z,ZT4-$           ;is found
8F87   FE3B        0740            CP £3B               ;is it a semi-colon?
8F89   20F0        0750            JR NZ,ZT3-$          ;if not, continue cory
8F8B   AF          0760            X0R A                ;if so, end of line
8F8C   12          0770            LD (DE),A            ;mark end of line in
```

```
8F8D  3D        0780           DEC A                ;Zeap with 00,£FF
8F8E  13        0790           INC DE
8F8F  12        0800           LD (DE),A
8F90  13        0810           INC DE               ;put start of free
8F91  ED530D1B  0820           LD(EDBUFF),DE        ;memory in EDBUFF
8F95  D1        0830           POP DE               ;restore DE andHL
8F96  21A18E    0840           LD HL,BUFF + 26      ;and return toRevas
8F99  C3098E    0850           JP NORMST + 9        ;output routine
8F9C  21068E    0860  REPTCH   LDHL,NORMST+6        ;replace patch for
8F9F  3621      0870           LD (HL),£21          ; normal start
8FA1  21A18E    0880           LD HL,BUFF  26
8FA4  22078E    0890           LD  (NORMST + 7),
8FA7  C3618E    0900           JP ESTRT
0002            0910  LINENO   DEFS 2
```

One problem with Zeap is that although the assembler options are reset to zero each time Zeap is re-entered, the memory offset P is not reset. Having overwritten a program I wished to save by forgetting to reset P, I decided to add a patch to display the current values of the control parameters. It also shows the starting address of the label store. When recording a program on tape you only need to record from £1BOD to the address LB.

```
0F6A            0005           ORG £0F6A
0F6A  FD7E01    0010  WRTOPQ   LD A,(IY + 1)        ;get assembler options
0F6D  11D00B    0015           LD DE,£BD0           ;set cursor
0F70  CD6514    0020           CALL RSTCR1
0F73  CD4402    0025           CALL B2HEX           ;display options
0F76  2A190F    0030           LD HL, (OFFSTO)      ;get offset in HL
0F79  11D50B    0035           LD DE,£BD5           ;set cursor
0F7C  CD6514    0040           CALL RSTCR1
0F7F  CD3202    0045           CALL TBCD3           ;display offset
0F82  2A240F    0050           LD HL,(LINDEL)       ;get delay in HL
0F85  11DC0B    0055           LD DE,£BDC           ;set cursor
0F88  CD3202    0060           CALL RSTCR
0F8B  CD3202    0065           CALL TBCD3           ;display delay
0F8E  2A0D1B    0070           LD HL,(£1B0D)        ;end of edit buffer
0F91  11E50B    0073           LD DE,£BE5           ;set cursor
0F94  CD6514    0080           CALL RSTCR1
0F97  CD3202    0085           CALL TBCD3           ;display end address
0F9A  118AOB    0090           LD DE,£B8A           ;restore DE
0F9D  C9        0095           RET
```

The screen heading, stored between £1003 and £1020, is changed to:—

```
£1000              4F 20 20 20 20
£1008     50 20 20 20 20 20 20 51
£1010     20 20 20 20 20 20 4C 42
£1018     20 20 20 20 20 20 20 46
£1020     4D
```

The subroutine WRTOPQ is called by a patch added at £1889.

```
1889    210310    0100              LD HL,TITLE        ;address in Zeap
188C    11CF0B    0105              LD DE,£BCF         ;position on screen
188F    011E00    0110              LD BC,30           ;number of characters
1892    EDB0      0115              LDIR               ;copy to screen
1894    CD6A0F    0120              CALL WRTOPQ        ;insert values
1897    CD6514    0130              CALL RSTCR1        ;reset cursor
189A ;end of patch
```

The third patch adds two editor commands; L lists the labels used in a program, and M outputs the label list to a printer. When adding this and the previous patch two points should be noted. Firstly, when any change is made to the Zeap program between £1000 and £1BOD a checksum error message (Error 90) will appear on the screen when Zeap is restarted. Secondly, the patches themselves are not protected by the parity check.

```
0E80              0005              0RG £E80
0E80    FE4C      0010    LABOUT    CP "L              ;test command character
0E82    280C      0015              JR Z LABLST        ;if L, list labels on VDU
0E84    FE4D      0020              CP "M              ;if M, print labels
0E86    C26817    0025              JP NZ DEFOLT       ;jump to default routine
0E89    FDCB00D6  0030              SET 2,(IY)         ;set output flag
0E8D    CDB213    0035              CALL CARRET        ;output £1F, £0D, and £0A
0E90    DD2A0D1B  0040    LABLIST   LD IX,(EDBUFF)     ;IX points to label addresses
0E94    210F1B    0045              LD HL, EDBUFF + 2  ;start of listing
0E97    CD8813    0050    LBL0      CALL SRCH1         ;find next line number
0E9A    CA1A18    0055              JR Z ST1           ;if zero, end of listing
0E9D    5E        0060              LD E,(HL)          ;get line number in DE
0E9E    23        0065              INC HL
0E9F    56        0070              LD D,(HL)
0EA0    23        0075              INC HL
0EA1    E5        0080              PUSH HL            ;gave address of line start
0FA2    ZA0C0C    0085              LD HL,(ARG1)       ;first line requested
0EA5    ED52      0090              SBC HL, DE         ;compare with current line no.
0FA7    E1        0095              POP HL             ;recover start of line
0EA8    280D      0100              JR Z,LBL1          ;jump if current line no. is
0EAA    380B      0105              JR C LBL1          ;equal or greater
0EAC    7E        0110              LD A,(HL)          ;test first character of line
0EAD    FE40      0115              CP £40             ;is it a letter (i.e., a label
0FAF    38E6      1020              JR C LBL0          ;if not, get next line
0EB1    DD23      0125              INC IX             ;if so, skip label address
0EB     DD23      0130              INC IX
0FB5    18E0      0135              JR LBL0            ;get next line
0EB7    2B        0140    LBL1      DEC HL             ;decrement HL to line number
0EB8    2B        0145              DEC HL
0EB9    CD7114    0150    LBL2      CALL ENDLIN        ;have we reached last line?
QEBC    DA1A18    0155              JP C, ST1          ;if so, stop
0EBF    23        0160              INC HL             ;increment HL to first
0EC0    23        0165              INC HL             ;character of line
0EC1    7E        0170              LD A,(HL)          ;test first character
0EC2    FE40      0175              CP £40             ;is it a letter?
0EC4    382E      0180              JR C,LBL4          ;if not, jump
```

```
0EC6   E5       0185           PUSH HL          ;save address
0EC7   EB       0190           EX DE,HL         ;put line number in HL
0EC8   CD3202   0195           CALL TBCD3       ;display line number
0ECB   E1       0200           POP HL           ;recover address
0ECC   11980B   0205           LD DE, £B98      ;reset cursor to £B98
0ECF   CD6514   0210           CALL RSTCR1
0ED2   11900B   0215           LD DE,£B90       ;start of second column
0ED5   CD8214   0220    LBL3   CALL PRTCHR      ;display the label
0ED8   38FB     0225           JR C,LBL3        ;
0EDA   EF2300   0230           DEFB £EF,£23,00  ;pound sign denotes hex.
0EDD   E5       0235           PUSH HL          ;save current address
0EDE   DD6E00   0240           LD L,(IX)        ;put label address into HI
0EE1   DD6601   0245           LD H,(IX   1)
0EE4   CD3202   0250           CALL TBCD3       ;display label address
0EE7   E1       0255           POP HL           ;recover current address
0EE8   DD23     0260           INC IX           ;increment IX to next
0EEA   DD23     0265           INC IX           ;label address
0EEC   3EA0     0270           LD A,£A0         ;£A0 marks end of line
0EEE   CD3B01   0275           CALL CRT
0EF1   CDC618   0280           CALL WTLBIT      ;output the line
0EF4   CD8813   0285    LBL4   CALL SRCH1       ;find next line
0EF7   18C0     0290           JR LBL2          ;continue
```

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Application Software for Micro Computers

PAUL RAYNER

Paul Rayner is the Managing Director of Great Northern Computer Services Ltd. This article is derived from his experience in developing and installing high quality business software.

THERE are a number of problems that face the designer of application software when he starts to work with micro computers which do not face his colleagues who are working with larger 'mini' and 'mainframe' computers. The most obvious problems stem from the characteristics of the equipment itself.

Micro-computers are small. Memory size available to any one user is normally limited to 64K. Up to half of this is taken up by the operating system and the language interpreter of compiler. This leaves 32K of 8 bit words for application programs. The result is that systems must be split up into separate programs that are 'CHAINed' together.

Disk storage is limited. Double and quadruple density diskettes are reducing this problem and, when proper back-up facilities are available, fixed 'Winchester' disks may remove it completely. But for the time being most users must fit their applications into less than 1 megabyte of disk storage.

This is adequate for simple systems for small businesses, but insufficient for complex systems. For example a 1 megabyte, two drive system can hold 5,000 part numbers in a simple stock control system. In a more complex system, with all outstanding orders and requisitions stored in a chained and indexed 'data base' structure, only about 2,000 part numbers could be held.

Rarely can a single file be spread over more than one diskette. This limits the maximum file size to 250,000 or 500,000 characters. To store more items (say 5,000 stock records of 150 characters each in a stock control system) some form of segmented file must be used. By this method the stock file becomes a series of small files scattered over the available drives, linked together by an index.

Limited disk space, combined with limited memory, can be a problem if one needs to sort large data files. There is neither the space for long strings in memory nor for large files on disk. One way of overcoming the problem is not to sort at all. Instead the necessary processing can be done by repeatedly scanning the file and pulling out successive items on successive scans. This is very slow but can be acceptable in jobs performed infrequently, such as month-end audit reports which are printed out after everything else has been processed.

On the whole, the micro-computer systems designer has time on his side. Volumes are relatively small and so he can use methods which are slow in order to save disk or memory space. The user who is replacing a manual system, which takes five days to do month-end accounts, will not complain if the micro-computer based replacement system takes five hours as opposed to four hours. Thus with skill and ingenuity in system design and programming, all the problems outlined above can be solved.

The more serious problems are not so easily dealt with. These are the ones that stem from the characteristics of the micro-computer market and from the characteristics of the people who use them.

The hardware for a good, reliable business micro-computer now costs around £5,000. This is a quarter of the price that would have been paid for a system with the same power only a few years ago. Unfortunately users expect the cost of software to have fallen in equal proportion. Thus the market place demands that software which could be sold for several thousand pounds if supplied to an IBM or ICL mainframe installation, can only be sold for a few hundred pounds when supplied to a micro-computer user.

The 'democratisation' of computing, which has resulted from the spread of micros, means that there are many people around with a basic knowledge of computers and BASIC programming. Such people provide a pool of part-time or 'moonlight' programming resource at 25% to 30% of the going rate for a full-time professional. Although such part-timers do not have the same depth of experience as the professional, and may not be available to help when the system comes unstuck at its first financial year-end, their effect is to depress the price that can be charged for quality commercial software.

The way out of this profit squeeze is for the software house to offer standard packages at low price. Instead of writing one system and selling it with some modifications to ten mini-computer users at £2,000 each, the professional software house must sell 80 packages with no modifications at £250 each.

For a package to sell in such volumes it must work with the widest possible range of equipment configurations and user requirements. This means that it must be designed to work with the typical commercial micro configuration; viz 8080/Z-80 processor, CP/M operating system, 48K memory and twin drive diskette unit. Such a computer will come with one of the standard BASICs, such as CBASIC2, and any of a wide range of V.D.U. and printer.

Because every V.D.U. has a different set of commands and command codes, packages should avoid using special V.D.U. features. This rules out 'sexy' screen formatting, but the benefit of such formatting is largely cosmetic, and, most users will not notice the loss. With languages such as CBASIC, those V.D.U. based commands, which have to be used, (such as clear screen), can be put into a sub-routine. The one subroutine can then be adjusted to suit the users V.D.U. and the altered code automatically 'INCLUDEd' in all programs when they are compiled.

One cannot, in Britain, assume that users will all have wide-carriage printers. This is a contrast to the U.S.A., where most business systems include a 'daisy wheel' printer, and, all have 132 or 120 column printers. Here is is best to design for 75 to 80 column printers. Such reports will also file nicely into A4 size ring binders, and, are thus much easier to read and transport then conventional full-width computer reports.

The biggest source of problems for the microcomputer systems designer is the user himself. Minicomputers or mainframer are run by trained data processing specialists. Micro-computers, by contrast, are run by existing staff, who have no special training, and, who all have other work to do. There is thus a premium on simplicity, ease-of-use and robustness.

In a small business there are not the clear demarcations of jobs that are found in larger organisations, for small businesses cannot afford specialists. Instead staff have to perform several functions. This will also apply to computer operation. Whilst one person should have overall responsibility for ensuring proper back-up of files, servicing, etc., any responsible member of staff, from Managing Director to secretary, should be able to use it.

It follows that the system must be easy to use. It must also be well documented, but, ideally, so designed that the user rarely needs to refer to the manual, since full instructions will be given on the V.D.U. screen.

The system should be 'foolproof'. If, for example, items should balance out to zero, then the program should check that they do and reject them if they do not. As another example, if the user is entering an account number, the program should verify that it exists, and should print out the account name so that the user can check visually. All this must be done without making the programs so large that they no longer fit within available memory.

Another characteristic of small business operation is that there are many interruptions. Staff must switch from job to job in response to events. Thus, for example, in the middle of entering the week's invoices the user must be able to stop and printout the current status of an account before returning to enter the rest of the invoices. This really means 'in-situ' updating of files. The alternative is a long, drawn-out process of entering data, sorting and updating before any enquiry can be made.

In-situ updating also means that if the computer is accidentally switched off, or, if there is a power cut, then at most only the last transaction entered is lost.

Probably the most important requirement of microcomputer application software is simplicity. Users rarely have either the time or the need for sophisticated systems. Often they are going from very basic manual or accounting machine systems. Thus the ideal system should require no changing of diskettes. Instead it should run just two diskettes; one for programs and one for data: because Where diskettes need to be changed in the middle of a run there is grave risk of confusion and error.

The actual features within the system need to be kept simple. This can be difficult. For example, most users want to get the benefits of 'Open Item Sales Ledgers. Yet the number of possible transactions on such a system (e.g. cash against earliest, cash against month, cash against invoice, overpayments, underpayments, etc.) are so great, and, the results of incorrect posting so potentially chaotic, that most micro-computer users are better off in the long run with a simple but effective 'Balance Forward' system.

With the basic equipment and the software so relatively inexpensive, the cost of media becomes significant. It is thus important to consider the cost of stationery. Wherever possible standard stationery should be used. The packages marketed by the Author only need one pre-printed form for all invoices and statements. These forms cost under £40.00 per 1,000. Even so, a user sending out only 600 statements a month can spend more on pre-printed stationery in one year than the total cost of the Sales Ledger package.

No matter how well the package is designed, and no matter how thorough the user manual, there will be times when the user needs training and support. Clearly the software house cannot provide such support within the prices discussed. For this reason it makes sense for packages to be supplied, along with the hardware, through reputable computer dealers. The dealer will then provide the training and the practical support during the first traumatic weeks of operation. If supplied with source code the dealer may also be able to make special 'customization' required by the user. In return the dealer will get a discount on the packages and will be able to sell more hardware by having good quality application software available off-the-shelf.

Selling standard packages through established dealers is very much the way that the problem of supplying application software for micros has been solved in the U.S.A. It is the Author's belief that this is also the best way to solve the problem in Britain.

Pets Corner J.Stout

BEFORE starting on the software for the PET in this issue, it should be said that the contents so far (in two issues) reflect very closely my interests as far as the PET is concerned, that is machine code and the writing of utility programs (programs to help other people write programs). Until readers start sending me some indication of their interests, if not actual articles to publish, that is the way it will stay.

THE PET REVEALED

This is an A5 size book, of about 260 pages, published by COMPUTABITS, LTD., P.O. BOX 13, SOMERSET, ENGLAND, for £10.00. The acknowledgements describes it as 'a collection of discoveries about the PET, how and why it works, and how to use these facts to write better programs and perform more interesting functions'.

After a fairly brief inspection of the book the following points should be made:

1 The book is written for the owner of a PET with OLD ROMs. A NEW ROM version should be out in the New Year. Nowhere in the advertising (principally Practical Computing) does it make this clear.
2 Its main interest would be to someone who is happy to use machine code since although it does provide a number of BASIC programs which can by typed in, the majority of information it provides (and it does provide a lot) would need to be applied in some specific way to be useful.
3 The book is well presented and printed, although the type face is a little small, but the binding used, gluing the pages into the cover, although presumably cheaper than other forms, means that very soon the pages start to fall out.
4 A lot of the book is concerned with hardware, both the hardware internal to the PET and external add-ons. Since one of the reasons many people have bought the PET is so that they need not get involved with the hardware, this approach seems at odds with the advertising for the book, which describes it as 'ESSENTIAL READING FOR ALL PET OWNERS'.

The general impression I gained of the book is that it would be ideal for someone who was accustomed to working in machine code and/or with a soldering iron, but that for someone who is happy with BASIC and has no wish to look inside the black box it is probably a waste of money.

There seem to be few actual mistakes in the book, although the text sometimes reads as though someone has missed out the punctuation. The section on 'adding new commands to BASIC' simply tells you how to link into the BASIC, not how to implement your own commands, and also leaves some questions unanswered, e.g. how do you make sure that your added command does not interfere with BASIC itself, how do you check that it is one of the extra commands that is to be executed and not a standard BASIC command.

To anyone thinking of buying the book I would be inclined to say that they should try and see a copy of it first before parting with £10. As 'essential reading for all PET users' it does not seem worth the money, but as a compilation of all the machine code facts that have appeared in numerous other magazines and books it may well be.

News from Canada

We are fortunate to have another letter from Jim Butterfield in Canada. He enclosed the following list of known entry points into the PET ROMs, which will be of great help to programmers in machine code. Although some supplementary work will need to be done to discover how to use the routines properly, at least they have been located. He also offers the following advice to such programmers:

ZERO PAGE usage with the new ROMs

i. If you are not using tape I/O, help yourself to locations $B1 to $C3 (177-195).

ii. If you do not use any ROM routines, locations $00 to $8C (0-140) may be swapped out, i.e. saved elsewhere, perhaps on the stack, and then restored before return to BASIC.

iii. Don't touch $8D to $B0 or $C4 to $FA (141-176 or 196-250), unless the interrupts are totally disabled, disabling keyboard, clock update and cursor flash.

iv. The only real need for page zero locations now is for indirect pointers, i.e. the (,X) and ( ),Y addressing modes of the 6502, since everything else can be moved elsewhere in memory without much effect on speed, although with a 50% increase in memory on instructions which reference data stored elsewhere. Since page zero space is now hard to get use it sparingly.

As a postscript to Jim's advice it is worth pointing out that most if not all of the problems in converting machine code programs to new ROMs from the old ones are concerned with page zero.

For readers who have encountered the PETUNIA or MTU music systems (which use an 8-bit digital to analog interface on the user port, Jim reports that Frank Covitz, who is responsible for most of the music currently available for the system, it putting the finishing touches to an advanced version, whose quality of sound Jim reports as being 'astonishing'. It will be available through MTU.

We have permission to reprint the circuit diagram of the interface from September 1978 BYTE, and are at the moment looking round for some software to go with it.

```
A few entry points, original/upgrade ROM     Jim Butterfield

Entry points seen in various programmer's machine language
programs.  The user is cautioned to check out the various
routines carefully for proper setup before calling, registers
used, etc.

ORIG UPGR     DESCRIPTION
C357 C355 ?OUT OF MEMORY
C359 C357 Send Basic error message
C38B C389 Warm start, Basic
C3AC C3AB Crunch & insert line
C430 C439 Fix chaining & READY.
C433 C442 Fix chaining
C48D C495 Crunch tokens
C522 C52C Find line in Basic
C553 C55D Do NEW
C56A C572 Do CLR
C59A C5A7 Reset Basic to start
C6B5 C6C4 Continue Basic execution
C863 C873 Get fixed-point number from Basic.
C9CE C9DE Send Return,LF if in screen mode
C9D2 C9E2 Send Return, Linefeed
CA27 CA1C Print string
CA2D CA22 Print precomputed string
CA49 CA45 Print character
CE11 CDF8 Check for comma
CE13 CDFA Check for specific character
CE1C CE03 'SYNTAX ERROR'
D079 D069 Bump Variable Address by 2
D0A7 D09A Float to Fixed conversion
D278 D26D Fixed to Float conversion
D679 D67B Get byte to X reg
D68D D68F Evaluate String
D6C4 D6C6 Get two parameters
D73C D773 Add (from memory)
D8FD D934 Multiply by memory location
D9B4 D9EE Multiply by ten
DA74 DAAE Unpack memory variable to Accum #1
DB1B DB55 Completion of Fixed to Float conversion
```

```
DC9F DCD9 Print fixed-point value
DCA9 DCE3 Print floating-point value
DCAF DCE9 Convert number to ASCII string
E3EA E3D8 Print a character
 na  E775 Output byte as 2 hex digits
 na  E7A7 Input 2 hex digits to A
 na  E7B6 Input 1 hex digit to A
F0B6 F0B6 Send 'talk' to IEEE
F0BA F0BA Send 'listen' to IEEE
F12C F128 Send Secondary Address
E7DE F156 Send canned message
F167 F16F Send character to IEEE
F17A F17F Send 'untalk'
F17E F183 Send 'unlisten'
F187 F18C Input from IEEE
F2C8 F2A9 Close logical file
F2CD F2AE Close logical file in A
F32A F301 Check for Stop key
F33F F315 Send message if Direct mode
 na  F322 LOAD subroutine
F3DB F3E6 ?LOAD ERROR
F3E5 F3EF Print READY & reset Basic to start
F3FF F40A Print SEARCHING...
F411 F41D Print file name
F43F F447 Get LOAD/SAVE type parameters
F462 F466 Open IEEE channel for output.
F495 F494 Find specific tape header block
F504 F4FD Get  string
F52A F521 Open logical file from input parameters
F52D F524 Open logical file
F579 F56E ?FILE NOT FOUND, clear I/O
F57B F570 Send error message
F5AE F5A6 Find any tape header block
F64D F63C Get pointers for tape LOAD
F667 F656 Set tape buffer start address
F67D F66C Set cassette buffer pointers
F6E6 F6F0 Close IEEE channel
F78B F770 Set input device from logical file number
F7DC F7BC Set output device from LFN.
F83B F812 PRESS PLAY..; wait
F87F F855 Read tape to buffer
F88A F85E Read tape
F8B9 F886 Write tape from buffer
F8C1 F88E Write tape, leader length in A
F913 F8E6 Wait for I/O complete or Stop key
FBDC FB76 Reset tape I/O pointer
FD1B FC9B Set interrupt vector
FFC6 FFC6 Set input device
FFC9 FFC9 Set output device
FFCC FFCC Restore default I/O devices
FFCF FFCF Input character
FFD2 FFD2 Output character
FFE4 FFE4 Get character
```

MENUS and the SCANNER alternative

To simplify the choices a user faces in running a program the concept of a menu is often used. The possible alternatives are displayed together with some sort of key, either numerical (1 Compiler, 2 Editor etc) or alphabetical (C Compiler, E Editor etc). By pressing one key on the keyboard the relevant option can be called up and executed. Whilst simple to program and relatively foolproof in operation, it makes the user adapt to the computer, rather than the computer to the user.

The alternative method illustrated here uses the idea of a SCANNER to break down a line of natural English into its component parts (also known as tokens or atoms). A token might be a number, a reserved word in the input language, or an identifier. Thus the user of an Adventure-type game might enter 'TAKE 3 PACES NORTH' and 4 successive calls to the SCANNER would return the reserved word 'GO', the number 3, the reserved word 'PACES' and the reserved worth 'NORTH'. For an assembler the input line might be 'LDA ($10,X)' and calls to the SCANNER would produce 'LDA', '(' 16 (the SCANNER is the best place to do hexadecimal-decimal conversions so that the rest of the assembler can work in decimal), ',', 'X' and ')'. In order to make transfer of control easy for BASIC a number might be returned describing which reserved word had been input, so than an ON . . . GOTO or GOSUB could be used.

The program listed illustrates the use of a SCANNER, and also includes the general line input routine mentioned in last issue. Subroutine 50100 returns in L$ the string entered by the user, with a null byte and a space appended to the end. LL is the total length of the string and CP (for Character Pointer) is set to zero, so that the SCANNER's first call to subroutine 50000 will result in the first character of L$ being returned in CH$. Subroutine 50100 allows the use of the delete key, but ignores all other cursor control characters. A string greater than 254 characters in length reports an error and restarts. The only other peculiarity is that " is changed to ' (double to single quotes). Commas, semicolons etc are dealt with normally, so BASICs aversion to dealing with commas etc in sentences (unless enclosed within quotes) is avoided.

The SCANNER program is borrowed almost unchanged from the P-Compiler in the October 1978 issue of BYTE (Mentioned In Last Issue). It is set up to return tokens from Pascal program lines, and in line 10 of the complete program N is the number of reserved words, LR is the maximum length of a reserved word and ML is the maximum length of an identifier (e.g. a variable name). RW$ is an array holding the reserved words. In line 20 SP$ becomes a string of ML spaces, used to left justify reserved words with less than LR characters. Lines 30-80 initialise the reserved word array, while line 80 initialises the SCANNER variables. Line 90 calls the SCANNER and prints the results from TK$(for ToKen string), SG$ (for StrinG string) and NR (for NumbeR). If the first byte of TK$ is a null then we have reached the end of a line (in Pascal this does not really matter, and was not included in the original SCANNER). If the first byte of TK$ has an ASCII value between zero and thirty-two it represents an error. TK$ = "%" is used as the terminator for the program.

50000 is the subroutine to get the next character from the line buffer L$ and move it to the character buffer (or look-ahead) CH$. If all the characters in L$ have been used (CP greater than or equal to LL) then a call is made to 50100 to clear L$ and read in a new line.

50100 as described before reads in an input line into L$.

50300 is the SCANNER proper. 50320 skips leading spaces. 50330 checks for a first significant character being a letter, in which case the letters and digits following it are added into SG$ to form the identifier or reserved word. Only the first ML characters are significant. A search is then made in lines 50390 to 50420 for a reserved word corresponding to the identifier. A possible alteration here would be to have in line 50340 RP = 0 and in line 50410 RP = RW: RW=N etc, so that on exit, if RP = 0 then we do not have a reserved word, otherwise RP acts as an index to the array of reserved words and can be used in an ON . . .GOTO statement. If the identifier is a reserved word then TK$ is set to the reserved word, otherwise TK$ is set to "IDENT" and SG$ contains the identifier name.

If the first significant character is a digit the SCANNER assumes a number is being input, sets TK$ to "NUM" and inputs the number to NR (lines 50450 to 50470). The number must be integer, and is limited to 10 digits. Lines 50480 to 50580 check for special symbols, which are written as a combination of two characters but stand for 1 token, e.g.: = , <> (not equal). Lines 50600 to 50620 take ' as introducing a string any build up the string into SG$. The error test in line 50620 will never be used (Why?). Lines 50650 to 50660 ignore comments (surrounded by exclamation marks) and lines 50680 to 50740 handle hexadecimal constants, which are preceded by '%'. If the input character does not fit into any of the categories mentioned it is simply returned as the token in 50670.

Notice the way that whenever the SCANNER has used a character it calls 50000 in order to get the next, but if it does not use it CH$ is left unchanged. In this way the routine can look 1 character into the future, in order to find out what is in store for it.

Further thoughts

Besides the array of reserved words the SCANNER could use an array of meaningless words, e.g. 'A', 'THE' etc, which it would pass over. Some type of scanner must of course be used in the input phase in BASIC, where the program text is turned into a series of tokens and stored in the memory. Similarly the famous ELIZA program probably contains one, although much more complicated than this. A thought for future expansion might be a scanner whose array of reserved words expands as type goes on, for example in an Animal game. For large sizes of arrays a more efficient search function should be used, e.g. binary search or hashing. A detailed look at the two complementary topics of searching and sorting will feature in the next PETs Corner.

ALTERATIONS FOR NEW ROMS

Lines 50120 and 50130: 548 should be 167. The cursor character in line 50130 is cursor left.

```
READY.
 10 N=32:LR=5:ML=8:DIM RW$(N)
 20 SP$="":FOR I=1 TO ML:SP$=SP$+" ":NEXT I
 30 FOR I=1 TO N:READ RW$(I):NEXT I
 40 DATA "AND  ",ARRAY,BEGIN,"CALL ","CASE ",CONST,"DIV  ","DO   ",DOWNT,"ELSE "
 50 DATA "END  ","FOR  ","FUNC ","IF   ",INTEG,"MEM  ","MOD  ","NOT  ","OF   "
 60 DATA "OR   ","PROC ","READ ",REPEA,"SHL  ","SHR  ","THEN ","TO   ","TYPE "
 70 DATA UNTIL,"VAR  ",WHILE,WRITE
 80 CH$=" ":CP=0:LL=0
 90 GOSUB 50300:PRINT TK$,SG$,NR
 95 IF (ASC(TK$)=0) THEN PRINT "END OF LINE.":GOTO 90
 98 IF (ASC(TK$)<32) THEN PRINT "ERROR:";ASC(TK$):GOTO 90
 100 IF (TK$<>"%") THEN 90
 110 STOP
 50000 REM GET A CHARACTER FROM THE LINE BUFFER L$.
 50010 IF (CP>=LL) THEN GOSUB 50100:GOTO 50010:REM IF PAST END OF LINE GET ANOTH
ER.
 50020 CP=CP+1:CH$=MID$(L$,CP,1):RETURN:REM MOVE TO NEXT CHARACTER AND READ TO B
UFFER.
 50100 REM READ A LINE TO VARIABLE L$.
 50110 L$="":REM LINE INITIALLY IS NULL.
 50120 POKE 548,0:GET KY$:IF (KY$="") THEN 50120:REM FLASH CURSOR AND GET KEY.
 50130 POKE 548,1:PRINT " ▮";:IF (ASC(KY$)=13) THEN 50220:REM RETURN=>END OF LIN
E.
 50140 IF (ASC(KY$)=34) THEN KY$="'":REM DON'T USE ".
 50150 IF (ASC(KY$)<>20) THEN 50190:REM DELETE KEY HAS ASCII CODE 20.
 50160 IF (LEN(L$)=0) THEN 50120:REM NOTHING IN LINE SO CAN'T DELETE.
 50170 PRINT KY$;:IF (LEN(L$)=1) THEN 50110:REM IF ONLY 1 CHARACTER IN LINE REST
ART.
 50180 L$=LEFT$(L$,LEN(L$)-1):GOTO 50120:REM DELETE LAST CHARACTER.
 50190 IF (ASC(KY$)<32) THEN 50120:REM IGNORE CONTROL CHARACTERS.
 50200 PRINT KY$;:L$=L$+KY$:IF (LEN(L$)<255) THEN 50120
 50210 PRINT:PRINT "LINE TOO LONG.":GOTO 50110:REM AND START AGAIN.
 50220 PRINT:L$=L$+CHR$(0)+" ":LL=LEN(L$):CP=0:RETURN:REM NULL LINE=CHR$(0)+" ".
 50300 REM GET A TOKEN (ATOM) FROM THE LINE IN L$.
 50310 REM RETURN TK$ FOR TOKEN TYPE, SG$ FOR STRING, NR FOR NUMBER VALUE.
 50320 IF (CH$=" ") THEN GOSUB 50000:GOTO 50320:REM FLUSH SPACES.
 50330 IF (CH$<"A")OR(CH$>"Z") THEN 50430:REM NOT A LETTER.
 50340 LI=0:SG$="":REM LI=LENGTH OF IDENTIFIER.
 50350 IF (LI<ML) THEN LI=LI+1:SG$=SG$+CH$:REM ML=MAXIMUM LENGTH OF IDENTIFIER.
 50360 GOSUB 50000:IF ((CH$>="A")AND(CH$<="Z"))OR((CH$>="0")AND(CH$<="9")) THEN
```

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Parallel Printer Interface Card	101.00	15.60	**116.60**

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Microprocessor
Z80A 8 bit CPU. This will run at 4 MHz but is selectable between 1/2/4/ MHz.

Hardware
12" x 8" Card
All bus lines are to the Nasbus specifications
All bus lines are full buffered

Memory
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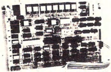
1K Work space/User RAM (MK4118)
8K Microsoft Basic
(MK3600 ROM)
8K Static RAM/2708 EPROM



Keyboard
New expanded 57 Key Licon solid state keyboard especially built for Nascom. Uses standard Nascom, monitor controlled, decoding.

T.V.
The T.V. Peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.

I/O
On-board UART (Int. 6402) which provides serial handling for the on-board cassette interface or the RS 232/20mA teletype interface. The cassette interface is Kansas City standard at either 1200 or 300 baud. This is a link operation on the Nascom-2.

PIO
There is also a totally uncommitted PIO (MK3881) giving 16, programmable, I/O lines.

Character Generator
The 1K video RAM drives a 2K ROM character generator providing the standard ASCII Character set with some additions, 128 characters in all. There is a second 2K ROM socket for an on-board graphics package which is software selectable.

	Nett	V.A.T.	Total
Nascom-2 in kit form	295.00	44.25	339.25
Power Supply ..	24.50	3.68	28.18
Graphics ROM ..	15.00	2.25	17.25

Superboard II

The sensational single board computer from Ohio Scientific. Superboard comes fully assembled and tested. On board is a 6502 microprocessor, 4K RAM (expandable, on board to 8K), 8K Microsoft BASIC in ROM, CUTS cassette interface, full ASCII keyboard. Superboard interfaces with a video monitor or domestic television (via U.H.F. Modulator) and provides a 24 x 24 display with Upper/Lower case and a wide range of graphics/gaming characters.

Superboard comes complete with documentation and sample software on cassette.

Ex-Stock

	Nett	V.A.T.	Total
Superboard II ...	188.00	28.20	216.20
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Peripherals
Full ASCII keyboard with 10 key rollover eliminates keyboard bounce. Expansion connector provides a parallel I/O Port for printer.

	Nett	V.A.T.	Total
Video Genie	369.57	55.43	425.00

Sharp

SHARP MZ-80K

· Z-80 based CPU.
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· Internal memory capacity from 4 to 48K RAM.
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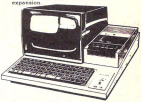


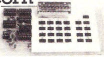
A complete personal computer system for the microcomputer user, at an economic price. The Sharp comes complete with all necessary peripherals, sample software and excellent documentation — giving the user a personal system of unmatched flexibility and ease of use. At the heart of the machine is the Z-80 CPU — widely accepted as the most powerful 8-bit CPU on the market. A 4K byte system monitor controls system operation. From 4 to 48K of RAM can be resident on board; enough room for the most demanding applications.

An extensive graphics character set, plus 3 octave sound generator and fast cassette unit hi-resolution video monitor complement these basic facilities. It has the ease of use and compactness of "black box" computer combined with extensive peripherals and facilities for expansion.

Sharp Basic occupies 14K of RAM: and offers extended features above those of normal microcomputer implementations;

Model	Nett	V.A.T.	Total
6K..............	520.00	78.00	598.00
10K	540.00	81.00	621.00
18K	620.00	93.00	713.00
22K	640.00	96.00	736.00
34K	740.00	111.00	851.00

Acorn



This compact stand-alone micro-computer is based on Eurocard modules, and employs the highly popular 6502 MPU. Take a look at the full specifications, and see how Acorn meets your requirements.

The Acorn consists of two single Eurocards:
1. MPU card; 6502 microprocessor, 512 x 8 ACORN Monitor; 1K x 8 RAM; 15-way I/O with 128 bytes of RAM; 1 MHz crystal; 5V reg sockets for 2K EPROM and second RAM I/O chip.
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Acorn Operating Manual
With Acorn, you'll receive an operating manual that covers computing in full, from first principles of binary arithmetic, to efficient hex programming with the 6502 instruction set. The manual also includes a listing of the monitor programs and the instruction set, and other useful tabulations; plus sample programs.

	Nett	V.A.T	Total
Kit......................	65.00	9.75	74.75
Ready Built	75.00	11.25	86.25

Acorn Memory
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8K RAM (Kit)	95.00	14.25	109.25

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Nett	V.A.T.	Total
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NAS Corner

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50350
50370 REM ABOVE LINE ADDS CHARACTERS TO SG$ UNTIL NON-LETTER OR NON-DIGIT.
50380 REM NOW WE CAN DO A SEARCH FOR RESERVED WORDS, E.G. FOR, IF, THEN ETC.
50390 SR$=LEFT$(SG$+SP$,LR):REM SP$=ML SPACES. PAD OUT SR$ WITH SPACES.
50400 FOR RW=1 TO N:REM N=NUMBER OF RESERVED WORDS.
50410 IF (SR$=RW$(RW)) THEN RW=N:NEXT RW:TK$=SR$:RETURN:REM RESERVED WORD.
50420 NEXT RW:TK$="IDENT":RETURN:REM IF NOT RESERVED WORD ASSUME IDENTIFIER.
50430 NM$="":REM NM$ WILL HOLD STRING REPRESENTATION OF NUMBER INPUT.
50440 IF (CH$<"0")OR(CH$>"9") THEN 50480:REM SINCE NOT A NUMBER.
50450 TK$="NUM"
50460 NM$=NM$+CH$:GOSUB 50000:IF (CH$>="0")AND(CH$<="9") THEN 50460
50470 NR=VAL(LEFT$(NM$,10)):RETURN:REM WITH TK$="NUM" AND NR=VALUE OF NUMBER.
50480 REM NOT AN IDENTIFIER, RESERVED WORD OR NUMBER. TRY FOR SPECIAL SYMBOL.
50490 IF (CH$<>":") THEN 50520:REM IN PASCAL : MAY BE PART OF :=.
50500 GOSUB 50000:IF (CH$="=") THEN TK$=":=":GOSUB 50000:RETURN
50510 TK$=":":RETURN
50520 IF (CH$<>"<") THEN 50560:REM < MAY BE PART OF <> OR <=.
50530 GOSUB 50000:IF (CH$=">") THEN TK$="<>":GOSUB 50000:RETURN
50540 IF (CH$="=") THEN TK$="<=":GOSUB 50000:RETURN
50550 TK$="<":RETURN
50560 IF (CH$<>">") THEN 50590:REM > MAY BE PART OF >=.
50570 GOSUB 50000:IF (CH$="=") THEN TK$=">=":GOSUB 50000:RETURN
50580 TK$=">":RETURN
50590 IF (CH$<>"'") THEN 50640:REM ' INTRODUCES A STRING.
50600 TK$="STR":SG$="":REM START OF A STRING.
50610 GOSUB 50000:IF (CH$="'") THEN GOSUB 50000:RETURN
50620 SG$=SG$+CH$:IF (LEN(SG$)<255) THEN 50610:REM TO GET NEXT CHARACTER.
50630 TK$=CHR$(1):RETURN:REM ERROR 1.
50640 IF (CH$<>"!") THEN 50670:REM ! INTRODUCES A COMMENT.
50650 GOSUB 50000:IF (CH$<>"!") THEN 50650:REM SEARCH FOR END OF COMMENT.
50660 GOSUB 50000:GOTO 50300:REM GET TOKEN AGAIN.
50670 IF (CH$<>"%") THEN TK$=CH$:GOSUB 50000:RETURN:REM SOME CHARACTER IS TOKEN

50680 TK$="NUM":GOSUB 50000:NR=0:REM % INTRODUCES A HEXADECIMAL CONSTANT.
50690 FOR HD=1 TO 4:HX=ASC(CH$):IF (HX>=48)AND(HX<=57) THEN 50720
50700 IF NOT((HX>=65)AND(HX<=70)) THEN RH=HD:HD=4:NEXT HD:GOTO 50730
50710 HX=HX-7
50720 HX=HX-48:NR=NR*16+HX:GOSUB 50000:NEXT HD:RETURN
50730 IF (RH>1) THEN TK$=CHR$(2):RETURN:REM ERROR NUMBER 2.
50740 TK$="%":RETURN:REM A SIGN ON ITS OWN.
READY.
```

A routine to determine the number of bytes in a 6502 instruction

This routine, taking only 32 bytes, when passed the first byte of a 6502 instruction in the accumulator, returns the number of bytes in the entire instruction (either 1, 2 or 3) in the X register.

It is completely relocatable, and could form a useful routine to any program which needs to know the length of a 6502 instruction, e.g. a single step program, a relocator program or a disassembler.

```
NBYTES:   A2 01    LDX  #$01     ;Assume 1 byte long.
          C9 20    CMP  #$20     ;JSR ($20) is abonormal.
          F0 17    BEQ  THREE    ;JSR is 3 bytes long.
          29 9F    AND  #$9F
          F0 15    BEQ  ONE      ;0XX00000 (X=don't care) is 1 byte long.
          29 1D    AND  #$1D
          C9 19    CMP  #$19
          F0 0D    BEQ  THREE    ;XXX110X1 is 3 bytes long.
          29 0D    AND  #$0D
          C9 08    CMP  #$08
          F0 09    BEQ  ONE      ;XXXXX0X0 is 1 byte long.
          29 0C    AND  #$0C
          C9 0C    CMP  #$0C
          F0 01    BEQ  THREE    ;XXXX11XX is 3 bytes long.
TWO:      CA       DEX
THREE:    E8       INX
          E8       INX
ONE:      60       RTS           ;Return from subroutine with correct
                                 ;value for number of bytes in X register.
```

This routine was borrowed from the documentation for the ACORN colour display unit.

Corrections to last issue's PETs Corner

Page 13, column 1, line 6 ' = ' should be '<>' (not equal to).

Page 13, column 1, line 10 should be (not equal to).

Page 13, column 36 'N set to 0' should be 'N set to Ø' (zero).

Page 13, column 2, line 2 after 'ROMs' insert the following: 'This routine saves the registers of the 6502 on the stack and executes an indirect JMP instruction through locations $0219, $021A (old ROMs)'.

Page 13, column 2, line 4 before 'of RAM' insert 'respectively'.

Page 14, column 1, line 30 of the BASIC program, 'FOR 1' should be 'FOR I'

Page 14, column 1, line 40 of the BASIC program, 'POKE 1,M' should be 'POKE I,M'.

Page 14, column 1, line 70 of the BASIC program, '(cr). (cl) (cl) (cl)' should be '(cr) (cr). (cl) (cl) (cl)'.

Page 14, column 1, line 100 of the new ROMs alteration, 'IS' should be 'IF'.

Page 14, column 2, line 5, 'SE1' should be 'SEI'.

Page 15, column 1, line 6, 'TOTAL: o' should be 'TOTAL: = Ø (zero).

Page 15, column 2, STOP PRESS, line 1, '(pin 22)' should be '(pin 27)', and in steps 4 and 5 the 'characters around X(return) etc should not be entered.

The layouts on page 17 depict the arrangement and assignment of the registers in the 2 PIAs and 1 VIA on the PET main logic board.

Disabling the STOP key on a PET.

To disable the action of the STOP key on a PET, the following POKE command should be inserted in the BASIC program:

for old ROMs   POKE 537,136
for new ROMs   POKE 144,49.

These locations contain the low order byte of the interrupt routine address (discussed in last issue), and the values POKEd are simply the original values incremented by 3. Looking at the interrupt routine with a disassembler shows that the first task of the interrupt routine is to execute a JSR (jump to subroutine) instruction), which takes 3 bytes, so that the POKE results in this subroutine not being executed. The jiffy clock is also disabled by the POKE, but no other ill effects have been reported with this technique, although the original values should be POKEd back before attempting any tape input/output.

TAPE HANDLING HINTS

After writing the 'editorial' at the start of this section the following article was received from R. Cason, 15 Parkway, Sawbridgeworth, Herts., concerning the handling of tapes on the PET.

One of the most annoying things about the loading of programs and data from the PET's cassette is waiting for the FOUND . . . message. Even if a tape counter were provided the program header could still be missed, and hence the entire file missed by the operating system.

Mr Cason suggests connecting a SOUNDBOX (normally used for music making) to the USER PORT pin 6 (the first cassette read line) instead of the original connection to pin M (the CB2 output from the shift register on the VIA). On both SAVE and LOAD the following different sections of the tape should be recognisable from the sound they produce:

(a) the HEADER TONE
(b) the HEADER TOKEN
(c) the HEADER 'TITLE'
(d) the PROGRAM (or DATA)
(e) the HALF WAY POINT
(f) the SECOND COPY OF THE PROGRAM
(g) the END OF FILE TOKEN

With practice the HEADER of a particular file on a multi-file tape can be found using fast foward, play and rewind. After rewinding slightly a normal LOAD can be performed.

In addition the following should also be discernable:

(h) DROPOUTS
(i) CROSSTALK
(j) NOISE
(k) VARIATION IN PITCH DUE TO TIGHT CASSETTES
(l) PROGRAM/DATA DIFFERENCES

To use the SOUNDBOX normally Mr Cason suggests adding a 3 position switch to the SOUNBOX, position 1 being to pin M (for music), position 2 not connected (for OFF) and position 3 being to pin 6 (for the cassette). Pin N is the common connection (earth).

Mr Cason also uses an Hitachi TRQ 299 with Automatic Level Control and a Cue and Review facility, which allows fast winding using Cue to find the n'th file on a tape, then Review to position the tape before the HEADER. The tape can then be transferred to the PET cassette for LOADing.

Mr Cason's letter ends by asking if anyone can suggest a method of recovering data from a tape where the HEADER and part of the first copy of the DATA has been erased.

Having tried Mr Cason's suggestion I can report that it does work, although I only tried it on LOAD. It does seem practical to distinguish the various sections of the file, but I think I would prefer the extra expense of buying 12 or 15 minute tapes and only recording one program (possibly with multiple copies on each side) per tape. If this is not possible then Mr Casons's suggestion seem to offer a reasonably cheap and reliable method of storing more than one file per tape.

Nybbles

Nybbles 1

EVER tried neatly formatting headings etc., on print statements? Counting spaces for centreing etc. Try

```
10AS  "THIS IS A SAMPLE STRING" : REM Title etc.
20 PRINT TAB ((40-LEN(A$))/2);A$ : REM PRINT STRING CENTRED.
```

Nybbles 2

A MESSAGE from our sponsor??
Try this on your PET with new ROMS

```
WAIT 6502, 100
```

Nybbles 3

DID you know that before a 6502 does a memory write, it reads the addressed location? Any devices on the bus structure waiting for a memory access will receive two in short succession. This can lead to some very puzzling behaviour with custom interfaces!

Nybbles 4

EVER fancied the odd 16 bit register on your 6502? Steve Wozniak, designer of the Apple, implemented a 16 bit metor processor 6502 enhancement package known as 'SWEET-16-The 6502 Dream Machine',—as a sub routine in the Apple Integer Basic ROM set.

A full source listing and documentation was given in the November 1977 Byte. Sweet 16 has 15 16-bit registers, extensive pointer, stack manipulation capability but a very simple to use and understand instruction set.

Saves a lot of code, particularly in programs which require extensive 16-bit capability such as text editors, assemblers etc. Disadvantages are the reduced execution speed, plus you must have the interpreter ($189 Bytes) resident.

Chess for the Acorn

by LAURENCE HARDWICK

THE listing given is the hex dump of a chess program to run on an Acorn System 1. The second RAM/IO chip, IC 8, must be fitted as the program uses most of the maximum RAM in the system.

The program plays a fairly mechanical game but will make the player think, and teach him not to make too many mistakes. It is possible to set three levels of play ranging in average response time from 3 to 100 seconds. The program can also be set to play any one of 5 standard openings with the possibility of adding others if required.

LOADING THE PROGRAM

The program consists of four sections of machine code and one section of tables, loaded into the following locations.

0100 — 01B0 Section 1 Acorn RAM Page 1
0200 — 03FF Section 2 Acorn RAM Pages 2, 3
0980 — 09EF Section 3 RAM/I0 IC 2
0E80 — 0EEF Section 4 RAM/I0 IC 8
0030 — 00DF Data Block Tables Page 0

Take care as you load each section as an error at any point could destroy the program when it is run. It is preferable to save each section to tape after loading and checking.

When all sections are loaded, execution should be started at location 09A5.

PLAYING CHESS

The program represents the board and pieces as shown in Figure 1, each square on the board is described by it's co-ordinates relative to the computer's right hand square at location 0,0.

The program accepts the following commands:—

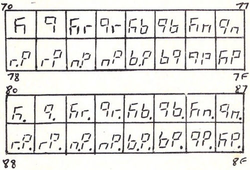
C Reset Board
E Exchange computer's and player's pieces
D Calculate computer's move
F Enter player's move

Each of these will now be described:—

C — When the C key is pressed the display will show XX CC CC, re-setting the board copies a table of initial positions, into a current position table. The initial position table starts at 70 and takes the following form:—

Location:—
Computer's pieces:—

Player's pieces:—



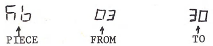
It is possible to set up any initial position of pieces from which to start, a captured piece is denoted in the table by CC.

After re-setting the board the program expects to play white and have first move.

E — When the E key is pressed the display will show

XX EE EE. Exchanging the board turns the board round so that the computer is still playing towards you from the 0,0 corner but now with black instead of white, or vice-versa. It is possible to exchange the board at any time and any number of times during the game.

D — The D key causes the computer to calculate its move, the display will flash for a while, showing the moves under analysis, and then show the move chosen in the following form:—



The computer can be asked to calculate a move at any stage during the game, even after it has just moved.

F — The F key allows the player to make his move, the 'from' and 'to' co-ordinates are entered in order and digits move into the field from right to left and are terminated by any monitor command key.

The piece field will only display correctly when the 'from' co-ordinates are occupied.

Having set up the required co-ordinates, the F key should then be pressed, care should be taken to make legal moves as no checks are made; it is possible for a player to take his own pieces even with an empty space! Any number of moves may be made to allow special positions to be set up and to allow castling.

EXAMPLE GAME

A typical game will start in the following way:—

Key Press	Display	Comment
G 09AS G	XX XX XX	Start program
C	XX CC CC	Clear board
D	FP 13 33	P - K4 Computer's move
63 43	FP.63 43	Set up P - K4 move
F	XX 63 43	Enter move
D	Fn01 22	K - KB3 computer's move

OPENINGS

The opening in the hex. dump is designed for the computer to play white in the Giuoco Piano defence.

The openings take the form of a table in locations C0—DB. Consecutive bytes downwards from DB inclusive are:—

a) The co-ordinates moved to in the player's last move, or C C in the case of a clear board command.

b) The address of the piece to be moved by the computer relative to the bottom of the current position table at 50.

c) The co-ordinates that this piece is to be moved to.

This pattern of three bytes describing player's move and programmed response is repeated for the first nine moves and is terminated by a 99 at location C0. Table 2 is a list of programmed openings for black or white for five of the most popular openings. If there is any deviation from the set opening the computer will continue to calculate moves as usual.

WINNING AND LOSING

If the computer wishes to resign or is in checkmate it will display XX FF FF. The program gives no indication of when the player is in check or checkmate and will take his King in that case.

DEPTH OF PLAY

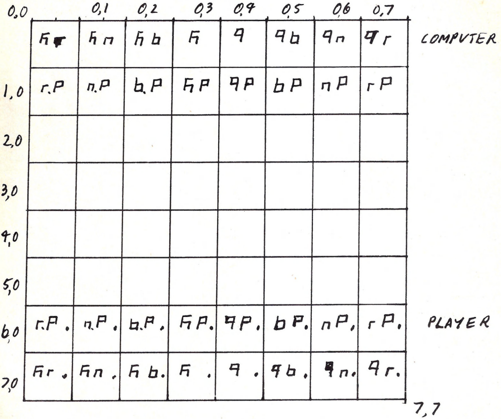
The depth of look ahead and the factors considered each time the computer calculates a move may be set to one of three levels:—

Average response time 3 seconds
Location 02F2 should contain 00
Location 018B should contain FF

Average response time 10 seconds
Location 02F2 should contain 00
Location 018B should contain FB

Average response time 100 seconds
Location 02F2 should contain 08
Location 018B should contain FB

Figure 1. Board and Piece Representation



The player's pieces are always identified by a decimal point following them.

TABLE 1

```
ACORN CHESS program block 1

0100: A6 B5 30 5C A5 B0 F0 08 E0 08 D0 04 C5 E6 F0 2E
0110: F6 E3 C9 01 D0 02 F6 E3 50 1E A0 0F A5 B1 D9 60
0120: 00 F0 03 88 10 F8 B9 A0 00 D5 E4 90 04 94 E6 95
0130: E4 18 08 75 E5 95 E5 28 E0 04 F0 03 30 31 60 A5
0140: E8 85 DD A9 00 85 B5 20 4B 03 20 B2 02 20 00 02
0150: 20 B2 02 A9 08 85 B5 20 09 02 20 31 03 4C 80 0E
0160: E0 F9 D0 0B A5 60 C5 B1 D0 04 A9 00 85 B4 60 50
0170: FD A0 07 A5 B1 D9 60 00 F0 05 88 F0 F1 10 F6 B9
0180: A0 00 D5 E2 90 02 95 E2 C6 B5 A9 FB C5 B5 F0 03
0190: 20 25 03 E6 B5 60 C9 08 B0 12 20 EA 03 A2 1F B5
01A0: 50 C5 FA F0 03 CA 10 F7 86 FB 86 B0 4C A5 09 73
ACORN CHESS program block 2

0200: A2 10 A9 00 95 DE CA 10 FB A9 10 85 B0 C6 B0 10
```

```
0210: 01 60 20 1E 03 A4 B0 A2 08 86 B6 C0 08 10 41 C0
0220: 06 10 2E C0 04 10 1F C0 01 F0 09 10 0E 20 8E 02
0230: D0 FB F0 D9 20 9C 02 D0 FB F0 D2 A2 04 86 B6 20
0240: 9C 02 D0 FB F0 C7 20 9C 02 A5 B6 C9 04 D0 F7 F0
0250: BC A2 10 86 B6 20 8E 02 A5 B6 C9 08 D0 F7 F0 AD
0260: A2 06 86 B6 20 CA 02 50 05 30 03 20 00 01 20 1E
0270: 03 C6 B6 A5 B6 C9 05 F0 EB 20 CA 02 70 8F 30 8D
0280: 20 00 01 A5 B1 29 F0 C9 20 F0 EE 4C 0D 02 20 CA
0290: 02 30 03 20 00 01 20 1E 03 C6 B6 60 20 CA 02 90
02A0: 02 50 F9 30 07 08 20 00 01 28 50 F0 20 1E 03 C6
02B0: B6 60 A2 0F 38 B4 60 A9 77 F5 50 95 60 94 50 38
02C0: A9 77 F5 50 95 50 CA 10 EB 60 A5 B1 A6 B6 18 75
02D0: 8F 85 B1 29 88 D0 42 A5 B1 A2 20 CA 30 0E D5 50
02E0: D0 F9 E0 10 30 33 A9 7F 69 01 70 01 B8 A5 B5 30
02F0: 24 C9 00 10 20 48 08 A9 F9 85 B5 85 B4 20 4B 03
0300: 20 B2 02 20 09 02 20 2E 03 28 68 85 B5 A5 B4 30
0310: 04 38 A9 FF 60 18 A9 00 60 A9 FF 18 B8 60 A6 B0
0320: B5 50 85 B1 60 20 4B 03 20 B2 02 20 09 02 20 B2
0330: 02 BA 86 B3 A6 B2 9A 68 85 B6 68 85 B0 AA 68 95
0340: 50 68 AA 68 85 B1 95 50 4C 70 03 BA 86 B3 A6 B2
0350: 9A A5 B1 48 A8 A2 1F D5 50 F0 03 CA 10 F9 A9 CC
0360: 95 50 8A 48 A6 B0 B5 50 94 50 48 8A 48 A5 B6 48
0370: BA 86 B2 A6 B3 9A 60 A6 E4 E4 A0 D0 04 A9 00 F0
0380: 0A A6 E3 D0 06 A6 EE D0 02 A9 FF A2 04 86 B5 C5
0390: FA 90 0C F0 0A 85 FA A5 B0 85 FB A5 B1 85 F9 4C
03A0: 80 09 A6 DC 10 17 A5 F9 D5 DC D0 0F CA B5 DC 85
03B0: FB CA B5 DC 85 F9 CA 86 DC D0 1A 85 DC A2 0C 86
03C0: B5 86 FA A2 14 20 02 02 A2 04 86 B5 20 00 02 A6
03D0: FA E0 0F 90 12 A6 FB B5 50 85 FA 86 B0 A5 F9 85
03E0: B1 20 4B 03 4C A5 09 A9 FF 60 A2 04 06 F9 26 FA
03F0: CA D0 F9 05 F9 85 F9 85 B1 60 05 F9 85 F9 85 B1
```

ACORN CHESS program block 3

```
0980: A5 F9 20 60 FE A5 FA A0 03 20 6F FE A5 FB C9 10
0990: 29 EF AA A9 00 85 15 6A 85 12 B5 30 85 10 B5 3F
09A0: 85 11 4C 0C FE D8 A2 FF 9A A2 C8 86 B2 A9 1F 85
09B0: 0E 20 80 09 B0 FB C9 0C D0 0F A2 1F B5 70 95 50
09C0: CA 10 F9 86 DC A9 CC D0 12 C9 0E D0 07 20 B2 02
09D0: A9 EE D0 07 C9 0D D0 0B 20 A2 03 85 FB 85 FA 85
09E0: F9 D0 C6 90 06 20 4B 03 4C 9D 01 4C 96 01 03 4C
```

ACORN CHESS program block 4

```
0E80: 18 A9 80 65 EB 65 EC 65 ED 65 E1 65 DF 38 E5 F0
0E90: E5 F1 E5 E2 E5 E0 E5 DE E5 EF E5 E3 B0 02 A9 00
0EA0: 4A 18 69 40 65 EC E5 ED 38 E5 E4 4A 18 69 90 65
0EB0: DD 65 DD 65 DD 65 E1 38 E5 E5 E5 E4 E5 E4 E5 E5
0EC0: E5 E5 E5 E2 A6 B1 E0 33 F0 16 E0 34 F0 12 E0 22
0ED0: F0 0E E0 25 F0 0A A6 B0 F0 09 B4 50 C0 10 10 03
0EE0: 18 69 02 4C 77 03 03 18 69 02 4C 77 03 79 99 83
```

```
ACORN CHESS data block

0030: 00 00 75 67 75 67 75 67 D0 50 D4 54 FC 7C 67 75
0040: 67 50 50 7C 7C 54 54 73 73 73 73 73 73 73 73 CC
0050: 04 36 07 00 05 02 06 01 17 10 16 11 15 12 13 34
0060: 74 55 77 70 75 72 76 71 67 60 66 61 65 62 63 44
0070: 03 04 00 07 02 05 01 06 10 17 11 16 12 15 14 13
0080: 73 74 70 77 72 75 71 76 60 67 61 66 62 65 64 63
0090: F0 FF 01 10 11 0F EF F1 DF E1 EE F2 12 0E 1F 21
00A0: 0B 0A 06 06 04 04 04 04 02 02 02 02 02 02 02 02
00B0: 01 36 C8 FB F9 04 00 AD 4B 6C B2 CF AA 78 AA 3C
00C0: 99 25 0B 25 01 00 33 25 07 36 34 0D 34 34 0E 52
00D0: 25 0D 45 35 04 55 22 06 43 33 0F CC EE 00 00 00
```

TABLE 2 PROGRAMMED OPENINGS

LOCATION	FRENCH DEFENCE		GIUOCO PIANO		RUY LOPEZ		QUEEN'S INDIAN		FOUR KNIGHTS	
	W	B	W	B	W	B	W	B	W	B
DB	CC	44	CC	44	CC	44	CC	43	CC	44
DA	0F	0F	0F	0F	0F	0F	0E	06	0F	0F
D9	33	24	33	34	33	34	34	25	33	34
D8	53	43	43	55	43	55	52	42	43	55
D7	0E	0E	06	07	06	07	00	0F	06	07
D6	34	33	22	22	22	22	35	24	22	22
D5	44	52	55	42	55	31	53	55	55	52
D4	07	06	04	04	04	06	06	0B	07	06
D3	25	25	35	32	46	25	22	21	25	25
D2	52	36	45	52	52	75	56	56	52	31
D1	05	04	0D	06	00	06	0A	05	04	04
D0	41	14	25	25	01	44	21	11	46	41
CF	63	34	52	43	33	43	66	66	36	73
CE	0F	06	0E	0F	0E	04	04	04	00	00
CD	43	13	34	43	34	14	11	14	01	00
CC	64	14	34	43	63	64	63	75	72	53
CB	05	01	00	04	01	06	00	00	0E	0E
CA	63	14	34	41	13	23	01	06	24	23
C9	63	63	36	52	54	22	72	52	54	36
C8	01	00	07	00	04	0B	07	06	05	04
C7	14	06	25	44	55	22	25	44	41	52
C6	72	45	33	75	55	34	33	62	25	52
C5	0C	00	00	06	0E	06	01	06	0B	01
C4	32	32	01	52	43	11	15	52	25	14
C3	45	55	25	52	66	52	25	52	63	74
C2	06	07	0B	04	07	00	01	0C	02	07
C1	22	22	25	52	25	06	25	35	03	03
C0	99	99	99	99	99	99	99	99	99	99

ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC
ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC
ETC ETC

ETCETERA

ETC ETC
ETC ETC
ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC
ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC
ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC ETC

LISP for the Apple II

OWL Computers announces its new software product for the Apple II computer—an interpreter for the language LISP. Apple LISP is intended for;

- university and school students who are learning LISP or carrying out research up to M.Sc level.
- hobbyists who want hands on experience of the fundamental language of artificial intelligence research.
- system designers who require more flexibility in data

LISP FUNCTIONS

ADD1
AND
APPLY
ASSOC
ATOM
BLANK
CALL
CAR
CDR
CAAR, CADR etc.
CAAAR, CAADR etc.
CHARACTER
CHARP
CHARS
COND
CONS
CR
DE
DIFFERENCE
DOLLAR
DOS
EDIT
EQ
ERROR
ERRORCOUNT
ERRORSET
EVAL
EXPLODE
F
FSUBRP
GET
GETCHAR
GREATERP
IMPLODE
LAMBDA
IN
LESSP
LIST
LISTP
LOAD
LOOP
LPAR
MAP
MAPC
MESSOFF
MESSON
MINUS
NIL
NOT
NULL
NUMBERP
OBLIST
ONEP
OR
ORDINAL
PAGE
PAGELINES
PEEK
PERIOD
PLIST
PLUS
POKE
PR
PRINO
PRINT
PROGN
PUT
QUOTE
QUOTIENT
READ
RECLAIM
REMAINDER
REMPROP
RPAR
RPLACA
RPLACD
SAVE
SET
SETQ
SUB1
SUPBRP
SUPERPRINT
SUPERVISOR
T
TIMES
UNDEFINEDVALUE
UNTIL
WHILE
ZEROP

and control structures than is provided by traditional programming languages.

The system consists of 6k bytes of machine code interpreter plus 4k bytes of initialised LISP workspace containing LISP utilities and constants. It is supplied on disc or cassette tape with a 44 page manual for a 16k or larger computer. Two demonstration programs are included.

The system has been designed with ease of use in mind. Important features include;

- fully interactive with explicit EVALUATE and VALUE IS messages
- automatic parenthesis count to help in typing complex expressions on the computer
- built in SUPERPRINTER to format the printing of large expressions
- editing by screen editing or built in LISP editor
- all errors trapped and optional full traceback printed

Owl Computers' LISP contains a number of extensions to basic LISP, including;

- character string processing
- PEEK, POKE, and CALL to control Apple hardware and machine code programs
- functions can have optional arguments with default values
- improved interactive control structures using LOOP, WHILE and UNTIL functions
- Apple DOS and input output control functions

The fast compacting garbage collector automatically finds space for numbers, lists or character strings if there is any space at all remaining. This means that the programmer need never be concerned about the details of storage allocation.

LISP is available from Owl Computers for £30 plus £4.50 VAT.

SUPER BASIC

Motorola are developing a 'Super Basic' called BASIC09 for the 6809. While compatible with existing interpreters it is intended to implement a large number of extensions, (largely inspired by Pascal with the

IF . . . THEN . . . ELSE
WHILE . . . DO
REPEAT . . . UNTIL

Procedures and user defined data types).

What makes it particularly interesting is that Motorola plan to burn it into a large ROM mass marketed at a low cost. Using the 6809 relative instructions it is to be position-independent-code with system independent calls for I/O.

With the announcement of 4K x 8 and 8K x 8 pseudo-static RAMS the £100.00 10 Chip PET does not seem far away!

BASIC09

Incremental Compiler—fast, syntax errors detected on entry.

Structured Procedure orientated—Named procedures, arbitrary length identifiers, local variables.

CALL Procedure with Parameters
TRACE

User defined data structures
Re-entrant
9 Decimal digits binary representation
Transcendentals accurate to 8 digits
'Print using'

Full set of normal Basic functions.

Basic09 is, say Motorola, a system development language (SDL) close to the power of Pascal.

VISICALC

This software package is rapidly making a name for itself. Available on the Apple and Hewlett Packards' new Capricorn micro, it is a 'visual pocket calculator, computer package which while requiring hardly any programming knowledge. Allows the user to handle a wide variety of mathematical problems simply and easily.'

Everyone I know who uses it seems to be totally addicted! Written by Personal Software, of Microchess fame, it costs $99 (or £99.00 if you buy it in Britain!)

FORTH LANGUAGE FOR THE PET

ACT Petsoft have introduced a modestly priced interactive FORTH Compiler/Interpreter to run on the best-selling PET microcomputer.

FORTH is a unique high level language, which has recently become popular in the United States, where it is widely used in astronomical and general scientific applications.

The principal advantages of the PET FORTH are that it is extremely fast and required only a small amount of memory. The language lends itself naturally to structured programming.

Petsoft's PET FORTH package contains a dictionary of 200 'words', each of which approximates to a subroutine in BASIC. Being vocabulary based the user can tailor the system to resemble the needs and structures of any specific application. Also included are a built-in incremental assembler and text editor.

PET-FORTH is available at £30 plus V.A.T. from ACT Petsoft, Radclyffe House, 66-68 Hagley Road, Edgbaston, Birmingham, B16 8PF.

SURROUND

DAVE STRAKER

SURROUND is a fast moving 'arcade' game for the Apple II or ITT 2020 written in APPLESOFT BASIC

```
10  REM <><><><> SURROUND <><><><>
20  REM
30  REM <>THIS VERSION BY DAVE STRAKER<>
40  REM
50  GOSUB 500: REM  INITIAL INFO PAGE
60  GOSUB 100: REM  GAME INITIALISATION
70  GOSUB 200: REM  RUN GAME
80  GOSUB 800: REM  FINALISE
85  IF  LEFT$ (Z$,1) = "Y"  THEN 60
90  TEXT : HOME : END
100  GR
102  IF D > 0 THEN 115
104 D = 2
110 CA = 2:CB = 9:CF = 14:CE = 0
115 C = GB
120  COLOR= CE: REM  BORDER
125  PRINT : PRINT : PRINT S$: PRINT
130  HLIN 0,39 AT 0: HLIN 0,39 AT 39: VLIN 0,39 AT 0: VLIN 0,39
140  COLOR= CF
150  FOR I = 1 TO 38: VLIN 1,38 AT I: NEXT I
170 XA = 17:YA = 17:XB = 22:YB = 22
180 AX = 1:AY = 0:BX =  - 1:BY = 0
182  IF D = 1 THEN  RETURN
184  GOSUB 1000
186  GOTO 120
190  RETURN
200  REM  MAIN LOOP
```

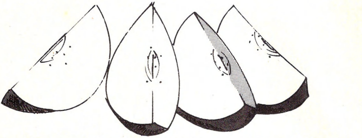
```
210  COLOR= CA: PLOT XA,YA
220  COLOR= CB: PLOT XB,YB
222  IF C < GF THEN 226
224 C = C - GD
226  FOR I = 1 TO C: NEXT I
230 PA =  PDL (0):PB =  PDL (1)
240  IF PA > 51 THEN 250
245 DA =  - 1: GOTO 270
250  IF PA > 204 THEN 260
255 DA = 0: GOTO 270
260 DA = 1
270  IF PB > 51 THEN 280
275 DB =  - 1: GOTO 300
280  IF PB > 204 THEN 290
285 DB = 0: GOTO 300
290 DB = 1
300  IF DA = 0 THEN 340
310  IF AX = 0 THEN 330
320 AY = AX * DA:AX = 0: GOTO 340
330 AX =  - AY * DA:AY = 0
340  IF DB = 0 THEN 380
350  IF BX = 0 THEN 370
360 BY = BX * DB:BX = 0: GOTO 380
370 BX =  - BY * DB:BY = 0
380 XA = XA + AX:YA = YA + AY
390 XB = XB + BX:YB = YB + BY
395 SA =  SCRN( XA,YA):SB =  SCRN( XB,YB)
400  IF CF = SA AND CF = SB THEN 210
410  RETURN
500  TEXT : HOME
510 S1$ = "<><><><><><><><><><><><><><><><><><><>"
520 S2$ = "<>                                  <>"
530 S$ = "<>             SURROUND             <>"
```

```
535  PRINT S1$: PRINT S2$: PRINT S$: PRINT S2$: PRINT S1$
540  PRINT : PRINT "    (THIS VERSION BY DAVE STRAKER)
550  PRINT : PRINT "THIS IS A TWO PLAYER,ARCADE-TYPE GAME."
560  PRINT "EACH PLAYER CONTROLS AN EXTENDING,"
570  PRINT "ORTHOGONALLY MOVING LINE WITH A PADDLE."
580  PRINT : PRINT " THE WINNER IS THE ONE WHO REMAINS FOR"
590  PRINT "THE LONGEST WITHOUT HITTING ANYTHING."
600  PRINT "THE SPEED WILL GRADUALLY GET FASTER"
610  PRINT "AND FASTER."
620  PRINT : PRINT "WHAT ARE YOUR NAMES?"
630  PRINT : INPUT "1ST PLAYER (PADDLE 0) ?";A$
640  PRINT : INPUT "2ND PLAYER (PADDLE 1) ?";B$
700  PRINT : INPUT "DIFFICULTY LEVEL(1-5) ?";Z$
710 Z =  VAL (Z$)
720  IF Z < 1 OR Z > 5 THEN 700
730 GD = 5
740 GB = 1055 - Z * 150
750 GF = GB - 300
760  RETURN
800  IF CF <  > SA AND CF <  > SB THEN 850
810  IF SA <  > CF THEN 830
820 CW = CA:W$ = A$: GOTO 840
830 CW = CB:W$ = B$
840 W$ = "CONGRATULATIONS," + W$ + ",YOU WIN."
845  GOTO 860
850 W$ = "..HOW ABOUT THAT! IT'S A DRAW!"
855 CW = CE
860  PRINT : PRINT S$
870  PRINT : PRINT W$
880  PRINT "      ....ANOTHER GAME? ";
890 Z =  PEEK ( - 16384): POKE  - 16368,0
900  IF Z > 127 THEN 960
```

```
905  FOR I = 1 TO 50: NEXT I
910  COLOR= CW
920  HLIN 0,39 AT 0: HLIN 0,39 AT 39: VLIN 0,39 AT 0: VLIN 0,39
925  FOR I = 1 TO 100: NEXT I
930  COLOR= CE
940  HLIN 0,39 AT 0: HLIN 0,39 AT 39: VLIN 0,39 AT 0: VLIN 0,39
950  GOTO 890
960 Z = Z - 128
970 Z$ =  CHR$ (Z)
975 D = 2
980  RETURN
1000  REM  CHOICE OF COLOURS
1010  COLOR= CA: PLOT XA,YA
1020  COLOR= CB: PLOT XB,YB
1025 D = 1
1030  PRINT : PRINT "THESE COLOURS OK? "; : GET Z$
1040  IF  LEFT$ (Z$,1) < > "N" THEN  RETURN
1045  HOME
1050  GR
1055 D = 2
1060  FOR I = 0 TO 15
1070  COLOR= I
1080  VLIN 0,39 AT I * 2: VLIN 0,39 AT I * 2 + 1
1090  NEXT I
1100  PRINT "0 1 2 3 4 5 6 7 8 9 1 2 3 4 5"
1110  PRINT "                    0 1 2 3 4 5"
1115  POKE 37, PEEK (37) - 1: POKE 36,0
1120  PRINT "BACKGROUND COLOUR"; : INPUT CF
1125  POKE 37, PEEK (37) - 1
1130  POKE 36,0: CALL  - 868: PRINT A$;"'S COLOUR"; : INPUT CA
1140  POKE 36,0: CALL  - 868: PRINT B$;"'S COLOUR"; : INPUT CB
1160  RETURN
```

Apple Pips

C.Phillips



Apple II Reference Manual

APPLE have done it again! Available shortly from your local dealer the new reference manual replacing the much loved (?) big red book of January 1978. The new manual is printed in the new standard 5 x 7 spiral bound format of the 'Applesoft', Dos 3.2 manuals and must surely be the last word in Apple documentation. It is divided into six sections:—

'Aproaching your Apple'
'Conversation with Apples'
'The System Monitor'
'Memory Organisation'
'Input/Output Structure'
'Hardware Configuration'

3 Appendices deal with:
'The 6502 Instruction Set'
'Special Locations'
ROM Listings'—The Autostart and 'old' F8 ROMS.

Finally a glossary, bibliography and five sepa indexes round off the coverage. Highlights include complete schematics of the main board, switching P.S.U. and keyboard, modifications for 'EURAPPLES', the 'mysterious' USER 1 jumper, complete ROM listings of both monitors, a detailed section on the system monitor with useful calls, operation of the different video modes, and using the Apple input/output structure with your own peripherals. Much of the information appears in print for the first time, and leaves little unsaid about the Apple. Eat your hearts out Commodore!

DISK FREE SPACE DOS 3.2 ONLY

This short sub-routine returns the number of free sectors on a disk in F1. As written the machine language code resides at $300—$322 (768—802 Dec) and is poked into memory by lines 10—50, Once resident the routine can be executed repeatedly by CALL 768.
The number of free sectors are in locations 6 and 7.

```
 5 REMDISK FREE SPACE 48K DOS 3.2 SYSTEM
10 FOR I = 768 TO 801 : READ B : POKE I,B : NEXT
20 DATA 32, 247, 175, 169, 0, 133, 6, 133, 7, 160, 56
30 DATA 185, 187, 179, 162, 7, 10, 144, 6, 230, 6, 208 2
40 DATA 230, 7, 202, 16, 244, 200, 192, 196, 144
50 DATA 96
60 CALL 768
70 FI = PEEK(6) + PEEK(7)*256
80 PRINT FI; 'SECTORS FREE'
90 END
```

For use at assembly level the routine can be executed by a JSR$300, returning the number of free sectors in locs 6 (low), 7 (high).

For users with less than 48K RAM the two absolute address references have to be altered accordingly.
For 32K systems lines 20 and 30 should read

```
20 DATA 32, 247, 111, 169, 0, 133, 6, 133, 7, 160, 56
30 DATA 185, 187, 115, 162, 7, 10, 144, 6, 230, 6, 208, 2.
```

For 16K Systems

```
20 DATA 32, 247, 47, 169, 0, 133, 6, 133, 7, 160, 56
30 DATA 185, 187, 51, 162, 7, 10, 144, 6, 230, 6,  208, 2
```

```
*300L

0300-   20 F7 AF    JSR   $AFF7
0303-   A9 00       LDA   £$00
0305-   85 06       STA   $06
0307-   85 07       STA   $07
0309-   A0 38       LDY   £$38
030B-   B9 BB B3    LDA   $B3BB,Y
030E-   A2 07       LDX   £$07
0310-   0A          ASL
0311-   90 06       BCC   $0319
0313-   E6 06       INC   $06
```

```
0315-     D0 02          BNE    $0319
0317-     E6 07          INC    $07
0319-     CA             DEX
031A-     10 F4          BPL    $0310
031C-     C8             INY
031D-     C0 C4          CPY    £$C4
031F-     90 EA          BCC    $030B
0321-     60             RTS
0322-     3F             ???
0323-     A9 5D          LDA    £$5D
```

APPLE TREK

Apple Star-Trek is one of the most popular and capable of its genre. Unfortunately it is written in Integer Basic/Machine Code and so is unusable on a 'bare' Europlus or 2020. ITT have released a version of Integer Basic on cassette/disk yet Trek fails to work with it because of its Machine Code portion; resident in memory at $3FAI. $FB6, right in the middle of your RAM based interpreter! The only pre-requisite to these alterations is an Integer Basic on ROM equipped Apple.

1) Load Apple-Trek.
2) DEL 18900, 32767
3) 50 GOTO 9005
4) 18900 END
5) 9010 I = 8 : X = Y = X2 = Y2 = K4 = V1 = V2 = V3 : DIM I$(8), D(9), A$(14), SD$(10), SDI$(10) : R5 = 63
6) Add these pokes.

```
20 POKE 768,160:POKE 769,50:POKE 770,162:POKE 771,0:POKE 772,138.
21 POKE 773,24:POKE 774,233:POKE 775,1:POKE 776,208:POKE 777,252
22 POKE 778 24:POKE 779,48:POKE 780,192:POKE 781,232:POKE 782,224.
23 POKE 783,3:POKE 784,208:POKE 785,242:POKE 786,136.
24 POKE 787,208:POKE 788,237;POKE  789.96:POKE 790.200
```

This, when saved, creates a 'stand alone' program. Remember that the machine language routine is poked in at S300 —any utilities you may have loaded there will be clobbered!

Relocating the Apple Miniassembler

ONE of the nicest features of the Apple system monitor is the tiny 6502 assembler resident at F500 .F668. Unfortunately APPLE-II Plus and 2020 owners no longer have it available—Applesoft needs that memory space. Using an Apple with Integer Basic on ROM type:

```
0C00<F500 .F63CM Return

0C337:0C
0C5B:0C
0CBF:0D
0CDD:0D
0CE7:0D
0D33:0C
```

To run type 0C92G
To save on disk BSAVE Mini-assembler which can be loaded off disk or cassette when needed.

Programming Quickies
'VAL' Function for integer Basic

```
>LIST
    5 DIM X$(10),X1$(10)
   10 REM   'VAL' FUNCTION FOR INTEGER BASIC
   20 CALL -936: VTAB 6
   30 INPUT "STRING =? ",X1$:X$=X1$
   40 GOSUB 899
   50 PRINT "STRING  ";X1$;"    VALUE IS ";Z
   55 PRINT " ": PRINT " "
   60 GOTO 30
  700 REM
  710 REM
  890 REM  ** SUBROUTINE **
  899 H=0:Z=H: REM  SET VALUE & H TO ZERO
  900 FOR K=1 TO LEN(X$)
  905 REM :LOOP TO GET FIRST NUMERIC CHARACTERS ONLY
  906 REM :ONLY LEADING NUMERICS ALLOWED
  910 F= ASC(X$(K,K))-176
  912 REM :FIND ASCII VALUE
  920 IF F>-1 AND F<10 THEN 940
  921 REM :BETWEEN 0 AND 9 ?
  925 IF K=1 THEN F=99
  926 REM : 1ST CHARACTER A LETTER ?
  930 K= LEN(X$): GOTO 950
  935 REM :EXIT LOOP
  940 H=H+1
  945 REM :INCREMENT H
  950 NEXT K
  954 IF F=99 THEN RETURN
  955 X$=X$(1,H)
  965 H=H-1
 1000 REM : X$ IS NOW ONLY NUMERIC STRING
 1010 FOR K=1 TO LEN(X$)
 1015 XX= ASC(X$(K,K))-176
 1040 XX=XX*(10 ^ H)
 1050 H=H-1:Z=Z+XX
 1060 NEXT K
 1065 RETURN
 9998 REM
 9999 REM ** ROUTINE BY G JONES
10000 REM **
10001 REM ** HELP YOURSELF
>
>
>RUN
STRING =? 12345
STRING  12345   VALUE IS 12345
.
.

STRING =? ABCDE
STRING  ABCDE   VALUE IS 0
.
.

STRING =? 123EF
STRING  123EF   VALUE IS 123
.
.


STRING =? D4R5T
STRING  D4R5T   VALUE IS 0
.
.

STRING =? 3E4R
STRINBLUEE4B 0 VALUE IS 3
```

Look!

```
?SYNTAX ERROR
]LIST
10000  REM  LOOK ! PAUL FULLWOOD
10010  REM  PROGRAM PRINTS MAJOR
10020  REM  APPLESOFT POINTERS AND
10030  REM  THEIR VALUES
10040  PRINT "HIMEM IS SET TO          "; PEEK (115) + ( PEEK (116) * 25
     6)
10050  PRINT "STRINGS COME DOWN TO     "; PEEK (111) + ( PEEK (112) * 25
     6)
10060  PRINT "NUMERICS GO UP TO        "; PEEK (109) + ( PEEK (110) * 25
     6)
10070  PRINT "VARIABLES GO UP TO                    "; PEEK (107) + ( PEEK
     (108) * 256)
10080  PRINT "LOWMEM IS SET TO         "; PEEK (105) + ( PEEK (106) * 25
     6)
10090  PRINT "PROGRAM TOP IS SET TO    "; PEEK (175) + ( PEEK (176) * 25
     6)
10100  PRINT "PROGRAM BOTTOM IS SET TO"; PEEK (103) + ( PEEK (104) * 25
     6)
```

Novel Sort

```
]LOAD SORT
]LIST
10  REM  SUPER-SORT ROY STRINGER 1980
15  REM  LINEAR SORT
20  CALL  - 936
30  INPUT X
40  DIM A(X): DIM B(X * 3):P = ((X * 3) * (4 / 5000))
50  FOR I = 1 TO X:A = ( RND (2) * 1000):A(I) = A: PRINT I,A: NEXT I
60  FOR I = 1 TO X:C =  INT (A(I) * P): IF B(C) > 0 THEN 140
70 B(C) = I: NEXT
80  PRINT " ","OLD","NEW"
90  FOR I = 0 TO X * 3: IF B(I) = 0 THEN 110
100 D = D + 1: PRINT A(B(I)),B(I),D
110  NEXT : END
120 C = C + 1
130  IF A(B(C)) = 0 THEN 70
140  IF A(B(C)) < A(I) THEN 120
150 F = C
160 F = F + 1: IF B(F) > 0 THEN 160
170 B(F) = B(F - 1):F = F - 1: IF F > C THEN 170
180  GOTO 70
```

65Ø2 Instructions Sorted by Op-Code

```
00              BRK
01  00          ORA    ($00, X)
02              ???
03              ???
04              ???
05  00          ORA    $00
06  00          ASL    $00
07              ???
08              PHP
09  00          ORA    £$00
0A              ASL
0B              ???
0C              ???
0D  00  00      ORA    $0000
0E  00  00      ASL    $0000
0F              ???
10  00          BPL    $0002
11  00          ORA    ($00), Y
12              ???
13              ???
14              ???
15  00          ORA    $00, X
16  00          ASL    $00, X
17              ???
18              CLC
19  00  00      ORA    $0000, Y
1A              ???
1B              ???
1C              ???
1D  00  00      ORA    $0000, X
1E  00  00      ASL    $0000, X
1F              ???
20  00  00      JSR    $0000
21  00          AND    ($00, X)
22              ???
23              ???
24  00          BIT    $00
25  00          AND    $00
26  00          ROL    $00
27              ???
28              PLP
29  00          AND    £$00
2A              ROL
2B              ???
2C  00  00      BIT    $0000
2D  00  00      AND    $0000
2E  00  00      ROL    $0000
2F              ???
30  00          BMI    $0002
31  00          AND    ($00), Y
32              ???
33              ???
34              ???
35  00          AND    $00, X
```

```
36  00          ROL    $00, X
37              ???
38              SEC
39  00  00      AND    $0000, Y
3A              ???
3B              ???
3C              ???
3D  00  00      AND    $0000, X
3E  00  00      ROL    $0000, X
3F              ???
40              RTI
41  00          EOR    ($00, X)
42              ???
43              ???
44              ???
45  00          EOR    $00
46  00          LSR    $00
47              ???
48              PHA
49  00          EOR    £$00
4A              LSR
4B              ???
4C  00  00      JMP    $0000
4D  00  00      EOR    $0000
4E  00  00      LSR    $0000
4F              ???
50  00          BVC    $0002
51  00          EOR    ($00), Y
52              ???
53              ???
54              ???
55  00          EOR    $00, X
56  00          LSR    $00, X
57              ???
58              CLI
59  00  00      EOR    $0000, Y
5A              ???
5B              ???
5C              ???
5D  00  00      EOR    $0000, X
5E  00  00      LSR    $0000, X
5F              ???
60              RTS
61  00          ADC    ($00, X)
62              ???
63              ???
64              ???
65  00          ADC    $00
66  00          ROR    $00
67              ???
68              PLA
69  00          ADC    £$00
6A              ROR
6B              ???
6C  00  00      JMP    ($0000)
6D  00  00      ADC    $0000
```

```
6E 00 00    ROR    $0000
6F          ???
70 00       BVS    $0002
71 00       ADC    ($00),Y
72          ???
73          ???
74          ???
75 00       ADC    $00,X
76 00       ROR    $00,X
77          ???
78          SEI
79 00 00    ADC    $0000,Y
7A          ???
7B          ???
7C          ???
7D 00 00    ADC    $0000,X
7E 00 00    ROR    $0000,X
7F          ???
80          ???
81 00       STA    ($00,X)
82          ???
83          ???
84 00       STY    $00
85 00       STA    $00
86 00       STX    $00
87          ???
88          DEY
89          ???
8A          TXA
8B          ???
8C 00 00    STY    $0000
8D 00 00    STA    $0000
8E 00 00    STX    $0000
8F          ???
90 00       BCC    $0002
91 00       STA    ($00),Y
92          ???
93          ???
94 00       STY    $00,X
95 00       STA    $00,X
96 00       STX    $00,Y
97          ???
98          TYA
99 00 00    STA    $0000,Y
9A          TXS
9B          ???
9C          ???
9D 00 00    STA    $0000,X
9E          ???
9F          ???
A0 00       LDY    £$00
A1 00       LDA    ($00,X)
A2 00       LDX    £$00
A3          ???
A4 00       LDY    $00
A5 00       LDA    $00
```

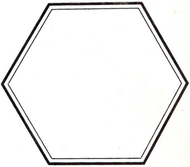
```
A6 00       LDX    $00
A7          ???
A8          TAY
A9 00       LDA    £$00
AA          TAX
AB          ???
AC 00 00    LDY    $0000
AD 00 00    LDA    $0000
AE 00 00    LDX    $0000
AF          ???
B0 00       BCS    $0002
B1 00       LDA    ($00),Y
B2          ???
B3          ???
B4 00       LDY    $00,X
B5 00       LDA    $00,X
B6 00       LDX    $00,Y
B7          ???
B8          CLV
B9 00 00    LDA    $0000,Y
BA          TSX
BB          ???
BC 00 00    LDY    $0000,X
BD 00 00    LDA    $0000,X
BE 00 00    LDX    $0000,Y
BF          ???
C0 00       CPY    £$00
C1 00       CMP    ($00,X)
C2          ???
C3          ???
C4 00       CPY    $00
C5 00       CMP    $00
C6 00       DEC    $00
C7          ???
C8          INY
C9 00       CMP    £$00
CA          DEX
CB          ???
CC 00 00    CPY    $0000
CD 00 00    CMP    $0000
CE 00 00    DEC    $0000
CF          ???
D0 00       BNE    $0002
D1 00       CMP    ($00),Y
D2          ???
D3          ???
D4          ???
D5 00       CMP    $00,X
D6 00       DEC    $00,X
D7          ???
D8          CLD
D9 00 00    CMP    $0000,Y
DA          ???
DB          ???
DC          ???
DD 00 00    CMP    $0000,X
```

```
DE 00 00   DEC   $0000,X          EF           ???
DF         ???                    F0 00        BEQ   $0002
E0 00      CPX   £$00             F1 00        SBC   ($00),Y
E1 00      SBC   ($00,X)          F2           ???
E2         ???                    F3           ???
E3         ???                    F4           ???
E4 00      CPX   $00              F5 00        SBC   $00,X
E5 00      SBC   $00              F6 00        INC   $00,X
E6 00      INC   $00              F7           ???
E7         ???                    F8           SED
E8         INX                    F9 00 00     SBC   $0000,Y
E9 00      SBC   £$00             FA           ???
EA         NOP                    FB           ???
EB         ???                    FC           ???
EC 00 00   CPX   $0000            FD 00 00     SBC   $0000,X
ED 00 00   SBC   $0000            FE 00 00     INC   $0000,X
EE 00 00   INC   $0000            FF           ???
```

APPLE II INTEGER BASIC SYSTEM 48K MEMORY MAP

FFFF	SYSTEM MONITOR	ON BOARD ROM
F800	SWEET 16	
F689	MINI ASSEMBLER	
F500	FLOATING POINT ROUTINES	
F425	INTEGER BASIC INTERPRETER	
E000	UNUSED	
D800	PROGRAMMERS AID #1 GRAPHICS, MUSIC, RELOCATE, MEMORY TEST	
D000	EXPANSION PROM SPACE	I/O RESERVED LOCATIONS
C800	I/O RESERVED LOCATIONS	
C000	DOS (if booked)	
95FF	USER RAM	HIMEM
5FFF	HI-RESOLUTION GRAPHICS 2 (if used)	RAM
3FFF	HI-RESOLUTION GRAPHICS 1 (if used)	
1FFF	USER RAM	
0BFF	SECONDARY TEXT PAGE (if used) LOW RESOLUTION GRAPHICS SCREEN 2	
07FF	PRIMARY TEXT PAGE LOW RESOLUTION GRAPHICS SCREEN 1	
03FF	SYSTEM MONITOR, DOS VECTORS	
03D0	UNUSED AVAILABLE FOR SHORT MACHINE LANGUAGE ROUTINES	
02FF	GETLN INPUT BUFFER	
01FF	6502 STACK	
00FF	SYSTEMS PROGRAMS—ZERO PAGE	
0000		

A HEX ON YOU



HEX–DECIMAL

HI	DECIMAL	H2	DECIMAL	H3	DECIMAL	H4	DECIMAL
0	0	0	0	0	0	0	0
1	4096	1	256	1	16	1	1
2	8192	2	512	2	32	2	2
3	12288	3	768	3	48	3	3
4	16384	4	1024	4	64	4	4
5	20480	5	1280	5	80	5	5
6	24576	6	1536	6	96	6	6
7	28672	7	1792	7	112	7	7
8	32768	8	2048	8	128	8	8
9	36864	9	2304	9	144	9	9
A	40960	A	2560	A	160	A	10
B	45056	B	2816	B	176	B	11
C	49153	C	3072	C	192	C	12
D	53248	D	3328	D	208	D	13
E	57344	E	3584	E	224	E	14
F	61440	F	3840	F	240	F	15

HEX ADDITION/SUBTRACTION

H1 H2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

HEX MULTIPLICATION/DIVISION

H1 H2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2	0	2	4	6	8	A	C	E	10	12	14	16	18	1A	1C	1E
3	0	3	6	9	C	F	12	15	18	1B	1E	21	24	27	2A	2D
4	0	4	8	C	10	14	18	1C	20	24	28	2C	30	34	38	3C
5	0	5	A	F	14	19	1E	23	28	2D	32	37	3C	41	46	4B
6	0	6	C	12	18	1E	24	2A	30	36	3C	42	48	4E	54	5A
7	0	7	E	15	1C	23	2A	31	38	3F	46	4D	54	5B	62	69
8	0	8	10	18	20	28	30	38	40	48	50	58	60	68	70	78
9	0	9	12	1B	24	2D	36	3F	48	51	5A	63	6C	75	7E	87
A	0	A	14	1E	28	32	3C	46	50	5A	64	6E	78	82	8C	96
B	0	B	16	21	2C	37	42	4D	58	63	6E	79	84	8F	9A	A5
C	0	C	18	24	30	3C	48	54	60	6C	78	84	90	9C	A8	B4
D	0	D	1A	27	34	41	4E	5B	68	75	82	8F	9C	A9	B6	C3
E	0	E	1C	2A	38	46	54	62	70	7E	8C	9A	A8	B6	C4	D2
F	0	F	1E	2D	3C	4B	5A	69	78	87	96	A5	B4	C3	D2	E1

HEX ASC11

H1 H2	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	·	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	”	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	/	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	1	!
D	CR	GS	–	=	M	]	m	}
E	SO	RS	.	>	N	∧	n	–
F	SI	US	/	?	0	–	o	DEL

HEX–HEX–BINARY–DECIMAL

HEX	HEX	BIN.	DEC
F	0	0000	0
E	1	0001	1
D	2	0010	2
C	3	0011	3
B	4	0100	4
A	5	0101	5
9	6	0110	6
8	7	0111	7
7	8	1000	8
6	9	1001	9
5	A	1010	10
4	B	1011	11
3	C	1100	12
2	D	1101	13
1	E	1110	14
0	F	1111	15

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Programming Practices and Technics

MICROCOMPUTER PROGRAMMING TECHNIQUES

COMPILERS AND INTERPRETERS

Part II

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Computer Laboratory
University of Liverpool.

apple
LIVERPOOL SOFTWARE GAZETTE

THE first article of this series looked briefly at the operation of assemblers and loaders. An assembler allows you to write your program as a series of machine instructions which are translated one-for-one into machine-code. This method produces programs which execute very rapidly, and, so long as reasonable care is taken, use the absolute minimum amount of store.

Whilst it is relatively easy to write the program once the problem has been redefined in a form which is suitable for computer solution, this redefinition is often a considerable effort. Much of the work required is of a systematic nature, and from the earliest days of computing it has been found possible to allow the computer to perform at least part of the task for us.

Early attempts (notably FORTRAN developed by IBM engineers in the 1950's to help them solve complicated mathematical formuli using computers, and still one of the most popular computer languages today) were aimed simply at reducing the amount of work required to code the programs required. The computer can be programmed to handle memory management and to generate code to do sequences of integer or floating-point arithmetic operations. More recently considerable thought has been given to easing other parts of the program designer's task, such as the organisation of the Data required, and simplifying the flow of control (notable recent attempts in this area being PASCAL and ALGOL 68).

Two different methods of translating programs written in a high-level. or algorithmetic language have been developed. A compiler works in much the same way as an assembler. The program text is translated by a special program which generates the machine code which can be executed by the microprocessor and places it in a file.

The difference is whereas an assembler generates only one operation code for each instruction, a compiler will generate the many operation codes needed to execute one high-level language statement. The programmer is relieved of the problems of allocating storage, and much repetitive coding, since they can be dealt with automatically perfectly adequately.

A very competent assembler programmer would be able either to save storage, or to shorten execution times, (or both), but it would be at the expense of considerable effort. Once the code has been generated it must be loaded into the computer, ready for execution. It is possible to delay storage allocation to this late stage, and so merge a series of program segments, possibly written in different languages. A special program called a loader does this for you. The ability to develop program modules independently is very important, since they can be reused in other programs when required, so long as there is adequate documentation as to their use, and the interface to the main program.

Interpreters work somewhat differently. An interpreter scans a line of text, and executes it immediately. This means that the program is stored in the computer as it was written by the programmer (or more usually in a slightly condensed form). The interpreter usually operates in two distinct ways, editing mode, when the program can be entered, or altered, and execution mode, when the program is actually executed. This dispenses with the need for a separate editor, but the facilities offered must be very limited if the size and complexity of the interpreter are to be kept within reason.

The program must be stored in the limited memory available within the microcomputer so the interpreter eliminates unnecessary characters, such as spaces, from each line before adding it to the program. More space may be saved if further processing is undertaken. Keywords can be encoded in single bytes, so long as they can be recreated later.

If, in addition, numbers are stored in floating-point format, instead of as typed, further considerable savings result. Since the program is executed directly from the programmer's code monitoring and debugging are particularly easy. Errors can be associated with individual lines of code very easily, and variables can be associated with the symbolic names associated with them by the programmer at every stage.

Sections of the program can be checked independently by executing them after initialising any variables with trial values since program execution can be controlled so intimately.

There are considerable advantages in using both an interpreter and a compiler, depending on the stage of development of the program. Since a compiler must produce object code for the target microprocessor, it has a far more difficult task than an interpreter. It is therefore much larger. Also some form of backing storage is required to store the code once it is produced. The advantage is that if the program is to be run many times without change, the translation is performed only once, saving considerable computer time.

The linking in of pre-compiled program segments is another considerable attraction in using a compiler. Once a program has been fully developed, and is in continuous use the continued use of an interpreter can be a considerable disadvantage since the immediate tracing and control facilities so useful at the development stage can lead to confusing and unpredictable error messages when used by others. Very clear documentation is required to cover events such as this.

Whilst BASIC is usually implemented with an interpreter and most other languages in common use with compilers, this need not necessarily be so. Several very good compilers have been written for BASIC and interpreters have been written for other languages. An interesting possibility is the use of an interpreter to develop and test the program, and then compiling the final version for repeated use.

It would save a lot of work if a compiler could be written in such a way that it would generate code for many microprocessors. This is of cause impossible since each microprocessor has its own instruction set. What can be done, however, is to write a Compiler which generates an 'intermediate' code, which does not necessarily correspond to the code needed for any particular microprocessor, but which can be run by using a program called a machine-code interpreter. This program takes the intermediate code and executes it, simulating the intermediate machine. The intermediate code can be designed to minimise the resources required by the compiler, which can run on the microcomputer system, if it is large enough, or on any other suitable computer.

The only reprogramming that is required to transfer programs to a new microcomputer system is the machine-code interpreter, a much simpler task than rewriting the whole compiler. If the machine-code interpreter is written carefully it is possible to achieve program execution times very close to those obtained when the compiler has been designed to generate directly executable machine-code. It is often possible to write the compiler in its own language and to run it using the machine-code interpreter, making the whole system transferable.

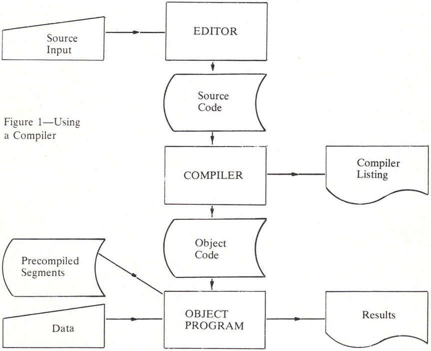
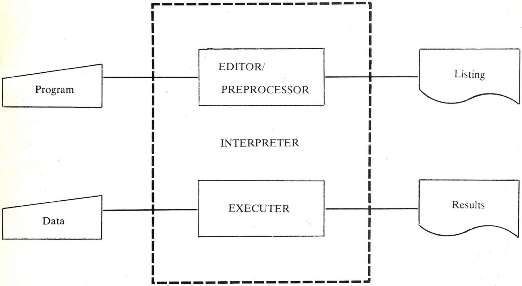


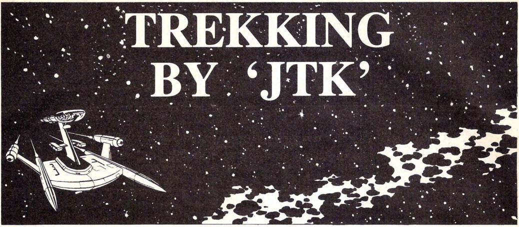
Figure 1—Using a Compiler

Figure 2: Using an Interpreter.


Program
Data
EDITOR/
PREPROCESSOR
INTERPRETER
EXECUTER
Listing
Results

TREKKING

BY 'JTK'



WITHIN 10 nanoseconds of coming out of warp the Klingon battle cruiser had fired its phasers. In that time Spatialcomp had informed Tacomp of the Federation freighter 5 miles ahead busily ferrying cargo to the planet surface below them both and Tacomp in turn had instructed Weapcomp to fire the phaser banks. It was traditional to open an encounter with speed of light weapons to inflict damage before the enemy could respond, the slower more powerful weapons being reserved till later in the engagement.

The attack had been inevitable for ten years now, ever since a crippled Federation freighter had drifted into Klingon territory giving the Klingons access to Federation tactical software.

Aboard the Federation freighter the sensors detected the Klingon cruiser and set off a course of events of galactic importance, determining whether the Klingons had finally overcome Federation supremacy. The freighters Execomp, busily supervising the unloading, switched out and Tacomp switched in, taking over command of the ship. Tacomp immediately directed the entire power of the warp drives into the rear deflector shields and started evasive action.

After checking a register to ensure there were no life forms aboard, the freighter accelerated under impulse power at 50 G and pulled a 20 G turn away from the planet surface. Simultaneously Comcomp sent a subspace signal to Federation H.Q. and a more important MASER encoder message to the planetary defence computer below.

Once the Federation were aware that the Klingons had their tactical software it started a race to ensure that the Federation would be ready when the Klingons attacked. On Earth two Hyper Intelligent Machines were run for a year and a half. One HIM simulated what the Klingons would do to overcome the Federation software advantage the other HIM simulated all the Federation alternatives to the simulated Klingon action.

The machines were locked in silent electronic conflict. The periodic reports of the simulation to Federation command were initially disappointing then disconcerting and finally frightening. They showed that no one side had the advantage, that encounters would be inconclusive, that anarchy would once again prevail.

The phasers struck as the freighter nosed into its turn. The shields absorbing the bulk of the blow, yet the damage was still considerable—the remaining cargo was all destroyed, the communications antennae blown off and impulse power down by 50%.

Federation command had set up a committee of people to find the solutions to their problem. The committee was carefully chosen, people with degrees in lateral thinking, alien psychology, temporal mechanics and a dozen other disciplines. The recommendations of the committee were devastating, federation command took a week to regain their composure but finally they saw the logic, they saw that it would work and they saw that they had no option. Klingon and Federation ships were virtually identical, centuries of plagiarising the better features of each others designs had resulted in an optimum piece of engineering.

The fourteen on board computers worked at the maximum theoretical speed, restrained only by the speed electrons can travel at, they were crammed together in a two inch sphere so as to talk to each other more rapidly and they were exposed to the absolute zero temperature of space so that their Josephson junction technology would work. The only hardware change the committee made was to reduce the number of computers to twelve, this gave the Federation a speed advantage over the Klingons but resulted in a loss of flexibility. The new software didn't need flexibility.

On board the freighter Navcomp made its last calculations very precisely and accurately and quadruple checked them. The freighter jumped into Hyperspace and re materialised at the same co-ordinates as the Klingon cruiser, so they both occupied the same volume in space, their molecules interlocked, both ships destroyed. It took three seconds for the plasma bolt to reach the ships from the planets surface, and afterwards the debris was so small, it didn't even register on radar.

At Federation command they had a party to celebrate, supremacy had been regained.

NASCOM NOTES

AN unclassifiable collection of hints for Nascom 1 and 2 owners, that have appeared in the vicinity of our desks.

RAM Board and the Nascom 2

Nascom-2 constructors please, please check that you have cut the 4K EPROM select P5-link 12 on your 16K RAM Board. As standard these are enabled for addresses.

F000-FFFF causing an address conflict with the Basic ROM which sits at E000 to FFFF.

8K Basic Bug?

Test for correct printing of 'ESC' Nas-2.

```
10 for I = 1 TO 1000
20 PRINT I;
30 PRINT CHR$(27);
40 NEXT
```

The above routine should print I (1-1000) then print 'ESC',which clears the line. At various values of I, i.e. 14, 26, 34, etc., the 'ESC' character is not printed and the display scrolls.

I have tried an equivalent routine in machine code, which is O.K. I have also tried it with the print statements in machine code, called by the 'USR' function this is also O.K.

This problem was discovered when trying to control a transtel printer which uses 'ESC' and a number to change its printing format.

HUMBLE PIE

'DEF Function name (variable name) = expression where the function name must be FN followed by a legal variable name and a 'dummy' variable name. The dummy variable represents the argument variable or value in the function call. *Only one argument* is allowed for a user defined function . . . .

Examples of valid functions are:

```
10 DEF FNAVE (V, W) = (V + W)/2
12 DEF FNRAD (DEG) =3.14159/180*DEG
```

From Nascom 8K Basic documentation
Over twenty phone calls at the last count.

ERRATA

Sargon meets the Nascom 1

Line 30 of the listing should read:—

```
09 ADD HL, BC; Next upper line
```

Our thanks to D. B. Newell for pointing this out. For those interested in graphics to go with SARGON, BITS and P.C.'S, 18 Rye Garth, Wetherby, West Yorks (Tel 0937-63744) sell a very nice Graphics Board, a set of Chess characters is an option.

M5

Page 20 0.2 Introduction

Commands which may be entered now are:
I (not 1) INPUT

1.1.2 The Current Valve

2) On encountering an identifier A-Z X takes the valve stored there.

A.1.3. Variables

As in most other languages, M5 has variables A-Z and a special one @

Page 24 3.1 Commands

Line 13 should read
Use: RN > > > > > >

Page 25 Line 9 should read

E:R > > > > > > > >

4.0 Error Messages

Line 5
ID ERR X . . .

Apple Pips Page 30

Integer Basic to Applesoft conversion should read

```
10 D$ = " " : DIM TITLE$(30)
20 INPUT "PROGRAM TITLE", TITLE$
30¾ POKE 76, PEEK(202) : POKE 77, PEEK(203)
40  PRINT D$; "LOAD", TITLE$
50   PRINT D$; "OPEN", TITLE$; ".TEX"
60  PRINT D$; "WRITE", TITLE$; ".TEX"
70  PRINT "FP"
80  LIST
90  PRINT D$; "CLOSE", TITLE$; ".TEX"
100 PRINT D$; "EXEC", TITLE$; ".TEX"
110 END
```

An alternative is to add the following lines to your program at unused line numbers.

```
1 D$ = " " : REM CTRL-D
2 PRINT D$; "OPEN TEXT" : PRINT D$; "WRITE TEXT"
: LIST: PRINT D$; "CLOSE TEXT" : END
```

RUN this then in direct mode type
FP return
EXEC TEXT return

Our apologies for these errors.

Byting more off your Disk

ONE of the fundamental laws of microcomputing states that, no matter how much disk capacity you have, it is not quite enough for the latest project, 'conventional' methods of using a disk on a microcomputer system make for a lot of overheads—in particular a large amount of available space is 'wasted' on the DOS (usually on the first few tracks of a disk) and directory/Track sector lists. This space is all necessary—supporting the operation of serial or Random Access, text, numeric, binary, files etc. and their use from BASIC. To take a specific example the Apple mini-floppy has 35 tracks, made up of 13 sectors each of 256 bytes. A total formatted capacity of 113.75K Bytes. However on each disk tracks $0-$2 are reserved for the DOS, Portions of $11 are normally reserved for the directory etc. All in all about 15% of available space is used by 'system' functions. In many applications the extensive support provided by the DOS is unnecessary but more capacity would be greatly appreciated.

Disk systems are normally classified as 'block-structured devices' data is not written on a character by character basis but instead written into a 'buffer' and where necessary the entire buffer written out or read from the disk. A buffer for disk is normally the same size as a disk sector. The overall control of reading and writing a sector to a specified part of the disk is handled by a low level set of sub-routines in DOS known as RWTS (Read/Write Track/Sector) in the Apple and various other designations on other systems, and their associated Device Control Block or Input Output Byte. (Most of this 'parlance' comes to the micro from mainframe practice.) These routines are fundamental to the operation of the disk and higher level DOS routines for creating and opening files, reading and writing files etc. will call them with appropriate parameters, to perform the menial tasks of interacting with the disk hardware. By setting up the appropriate parameters in the Input Output Byte and calling RWTS from a user program we can circumvent most of the intelligence of a disk system. On the Apple, RWTS provides four basic services.

Null Command—do nothing except position the head to the specifed track/sector.

Read—Read the specified track/sector into a buffer (256 bytes long in the Apple case)

Write—Write from the specified buffer to the Track/Sector

Format : Formats a minifloppy into 35 tracks of 13 sectors each of 256 bytes.

RWTS returns any error as an error code. 4 are normally used.

Write Protect error : Attempt was made to write to a write-protected disk.

Read error: After 48 repeated attempts the systems was unable to read the specified sector.

Drive error : Something funny is happening!

Volume number mis-match : The actual disk volume number does not match the expected one.

Similar routines available in most computer operating systems. If we set up the appropriate parameter in the Input/Output Byte with a format command and call RWTS with an unused disk in the drive (note: for all these operations DOS must be booted off another, conventional disk) we will have a neatly formatted disk with all 455 sectors available for our use. By calling RWTS we can read and write to any sector. Any file structures created will have to be maintained by the user program. Since our disks do not have any DOS stored the user will have to boot off another disk. What we have gained is capacity—116480 bytes to be precise and speed, as we are not going through any complex calculations before performing the operation.

Examples of applications that spring immediately to mind are stock control, mailing list, database management, graphics picture storage etc. Any application in fact where more speed and capacity would come in handy. To use RWTS we set up an Input/Output Byte in memory, a device characteristics table—Within the IOB we can specify slot, drive number, track/sector number, command (Null, Read, Write, Format), address of device characteristics table, expected volume number etc. In addition the address of a 256 byte data buffer. In the demonstration program I moved HIMEM down below a 256 byte area.

The program below demonstrates use of RWTS, it reads a special sector called the Volume Table of Contents off the disk and returns with the DOS version number, the volume number of the disk and where the disk directory begins. (See DOS 3.2 manual appendix C for further details.).

It uses Page 3 extensively:

$300 - 310 Input/Output
$311 - 314 Device Characteristics table
$315 - 31C Machine Language Driver

With small changes it could be used as a support program for any of the previously mentioned applications.

5 Sets Himem below buffer) Change for smaller
55 Buff is the base address of the data) memory size
buffer
60-170 Initialise various fields of I.O.B
180-290 Pokes I.O.B. into memory
295-310 Pokes device characteristics table into memory
320-330 Pokes machine language drive into memory

340 Calls RWTS via driver
350-380 Print various statistics on the disk? Ends.

The program was written to demonstrate use of RWTS, it is not a particularly elegant way of calculating the DOS version etc. Similar programs would be used on most other micros. For Apple Users who are expanding the routine pages 94-98 of the DOS 3.2 manual has further details of RWTS.

One addition needed are error handling routines (the easiest way would be to use the machine language drive to set a flag in page 0 that can then be peeked).

```
]-

]LIST

5  HIMEM: 38143

10  REM  VTOC ACCESS PROGRAM

20  REM  C. PHILLIPS

30  REM  COPYLEFT 1980

40  REM  ALL WRONGS RESERVED

50  CALL  - 936

55 BUFF = 38144: REM  FOR 48K SYS
     TEM

60 TYPE = 01: REM   IOB TYPE (MUS
     T BE 01 FOR DISK 11)

70  INPUT "SLOT NUMBER ";S

80  IF S < 1 OR S > 6 THEN 70

85 S = S * 16: REM  SLOT NUMBER *
     16

90  INPUT "DRIVE NUMBER ";D

100  IF D < 1 OR D > 2 THEN 90

110 VOL = 0: REM  VOLUME NUMBER

120 T = 17: REM  TRACK NUMBER

130 SEC = 0: REM  SECTOR NUMBER

140 CMD = 1: REM  READ COMMAND

150 PSN = S: REM  SLOT ACCESSED R
     ECENTLY

160 PDN = D

170  PRINT

180  REM ******************

190  REM  POKE I.O.B

200  REM ******************

210  POKE 768,TYPE

220  POKE 769,S

230  POKE 770,D

240  POKE 771,VOL

250  POKE 772,T

260  POKE 773,SEC

265  POKE 774,17: POKE 775,3

267  POKE 776,0: POKE 777,149

270  POKE 778,0: POKE 779,0: REM
      UNUSED

280  POKE 780,CMD

290  POKE 783,PSN: POKE 784,PDN

295  REM ****************

296  REM  POKE D.C.T.

297  REM  ****************

300  POKE 785,00: POKE 786,01

310  POKE 787,239: POKE 788,216

320  POKE 789,169: POKE 790,3: POKE
     791,160

330  POKE 792,0: POKE 793,32: POKE
     794,217: POKE 795,3: POKE 79
     6,96

340  CALL 789

350  PRINT "DOS VERSION 3."; PEEK
     (BUFF + 3)

355  PRINT

360  PRINT "VOLUME NUMBER "; PEEK
     (BUFF + 6)

365  PRINT

370  PRINT "DIRECTORY BEGINS AT T
     RACK "; PEEK (BUFF + 1);" SE
     CTOR "; PEEK (BUFF + 2)

380  END
```

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STOP PRESS

BYTE SHOP

THE Byte Shop chain of 6 computer stores in London, Birmingham, Manchester, Nottingham, Glasgow and Ilford, which recently went into receivership has been purchased by Comart Ltd. of St. Neots.

TANDY

Tandy are to introduce a colour graphics computer system, to plug into a domestic television, using a number of custom integrated circuits produced by Motorola—including a version of the 6847 Video Display Generator.

SINCLAIR

Clive Sinclair is to launch a £100.00 Z-80 based micro by the end of February.

APPLE PRICES DOWN!

From 1st February Apples are getting cheaper.

The 16K Europlus Apple with video output is now £695.00. A disk drive with controller £349.00. With 4116 RAM seemingly dropping in price daily a 48K Apple II with disk has now virtually halved in price since its introduction 2 years ago! All this in these inflationary times!

PET

The PET appears to have a considerable lead in software and sales in the U.K. More PETS are being sold here than on the American West Coast! With the tremendous number in use some really good software is becoming available–the PET Programmers Toolkit, the Commodore Assembly Language development system (that's almost as good as those available for the Apple—biased editor's note), PETAID etc. Latest rumours are of a full Pascal implementation for a 32K PET with the Run-time utilities and a P-Machine in ROM.

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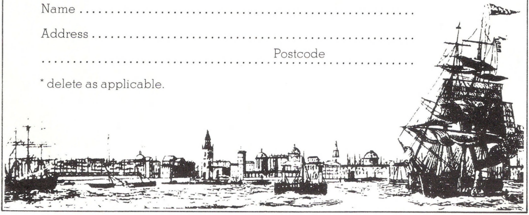

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